

Mullard

Book 1 Part 8

Mullard technical handbook

Microwave semiconductors
and components

Book one

Semiconductor devices

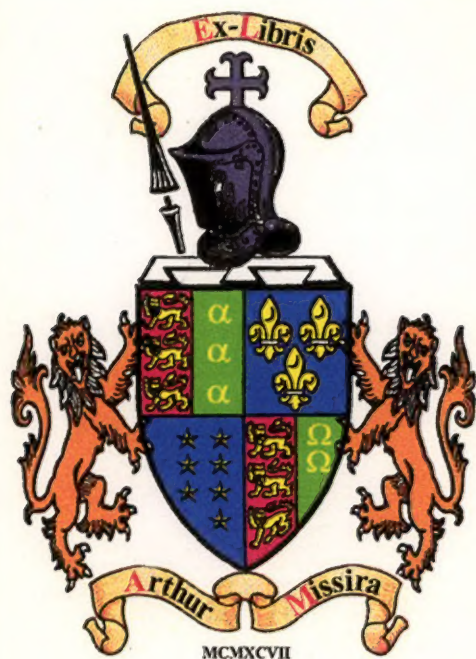
Part eight

**Microwave semiconductors and
components**

June 1979

June 1979





MICROWAVE SEMICONDUCTORS AND COMPONENTS

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Book 1 comprises the following parts—

- Part 1A Small-signal transistors
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 - Part 3 Diodes
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 - Part 6 LOCMOS digital integrated circuits
 - Part 7A Consumer integrated circuits
 - Part 7B Professional analogue integrated circuits
 - Part 8 Microwave semiconductors and components
 - Part 9 Opto-electronic devices (to be issued later)
- PLUS—**

Signetics Technical Handbooks

- Memories
- Microprocessors
- Analogue
- Logic

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BOOK 1 (Part 8)

SEMICONDUCTOR DEVICES

Microwave semiconductors **Microwave components**

Mullard manufacture and market electronic components under the **Mullard, Philips** and **Signetics** brands.

MULLARD LTD., MULLARD HOUSE, TORRINGTON PLACE,
LONDON, WC1E 7HD

Telephone 01-580 6633

Telex: 264341

DATA HANDBOOK SYSTEM

The Mullard data handbook system is made up of three sets of books, each comprising several parts, plus the Signetics technical handbooks.

The three sets of books, easily identifiable by the colours on their covers, are as follows:

| | | |
|--------|----------|--|
| Book 1 | (blue) | Semiconductor devices and integrated circuits |
| Book 2 | (orange) | Valves and tubes |
| Book 3 | (green) | Passive components, materials, and assemblies. |

Each part is completely reviewed annually; revised and reprinted where necessary. Revisions to previous data sheets are indicated by an arrow in the margin.

The data sheets contained in these books are as accurate and up to date as it is reasonably possible to make them at the time of going to press. It must, however, be understood that no guarantee can be given here regarding the availability of the various devices or that their specifications may not be changed before the next edition is published.

The devices for which full data is given in these books are those around which we would recommend equipment to be designed. Where appropriate, other types no longer recommended for new equipment designs, but generally available for equipment production are listed separately with abridged data. Data sheets for these types may be obtained on request. Older devices for which data may still be obtained on request are also included in the index of the appropriate part of each book.

Requests for information regarding the data handbook system (including Signetics data) and for individual data sheets should be made to the

Technical Publications Department
Mullard Limited
New Road
Mitcham
Surrey CR4 4XY
Telex: 22194

Information regarding price and availability of devices must be obtained from our authorized agents or from our representatives.

SELECTION GUIDE

SECTION B – GUNN, IMPATT AND NOISE DIODES

Gunn Effect Devices

| P _{out} min. (mW) | Type No. | Description | Operating Voltage (V) | P _{tot} max. (W) |
|----------------------------------|----------|---|-----------------------------|---------------------------------|
| 5 | CXY11A | Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations in X-band | 7.0 | 1.0 |
| 10 | CXY11B | | 7.0 | 1.0 |
| 15 | CXY11C | | 7.0 | 1.0 |
| 100 | CXY19 | | 8 to 15 | 6.0 |
| 200 | CXY19A | | 8 to 15 | 6.0 |
| 300 | CXY19B | | 8 to 15 | 7.5 |
| 50 | CXY21 | | 8.0 | 2.5 |
| 5 | CXY14A | Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations in J-band | 7.0 | 1.0 |
| 10 | CXY14B | | 7.0 | 1.0 |
| 15 | CXY14C | | 7.0 | 1.0 |
| 25 | CXY24A | Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations in Q-band (Ka-band) | 3.5 | 4.0 |
| 50 | CXY24B | | 3.5 | 4.0 |

Impatt Diodes

| P _{out} min. (mW) | Type No. | Description | Operating Voltage (V) | Frequency Range (GHz) |
|----------------------------------|----------|--|-----------------------------|-----------------------------|
| 500 | BXY50 | High efficiency silicon Impatt diodes for the generation of microwave c.w. power | 91 | 8 to 10 |
| 400 | BXY51 | | 80 | 10 to 12 |
| 300 | BXY52 | | 70 | 12 to 14 |
| 650 | BXY60 | | 120 | 6 to 8 |

Noise Diode

| Frequency Range | Type No. | Description | Typ. Excess Noise Ratio (dB) | Typ. Avalanche Voltage (V) |
|--------------------|----------|---------------------------|---------------------------------------|-------------------------------------|
| 10 Hz to 18 GHz | BAT31 | Broadband noise generator | 34 | 20 |

SECTION C – MIXER AND DETECTOR DIODES

Schottky Barrier Mixer Diodes

| Max. Operating Frequency (GHz) | Type No. | Description | I.F. Impedance (Ω) | Max. Noise Figure (dB) |
|---|--------------------------------------|----------------------|-----------------------------------|---------------------------------|
| 12 | BAT10 | Plastic package | 250–500 | 7.5 |
| 12 | BAT11 | L.I.D. | 280–380 | 7.0 |
| 12 | BAT50 BAT50R* | Rimmed coaxial | 300–500 | 6.8 |
| 12 | BAV22 BAV22R* | Rimmed coaxial | 300–550 | 7.5 |
| 12 | BAV96A BAV96B BAV96C BAV96D | M.Q.M. | 250–450 | 7.5 7.0 6.5 6.0 |
| 12 | BAW95D BAW95E BAW95F BAW95G | Reversible cartridge | 250–500 | 8.2 7.5 7.0 6.5 |
| 18 | BAT39 BAT39A | Mixer pill | 250–450 | 6.5 7.5 |
| 18 | BAT51 BAT51R* | Rimless coaxial | 220–320 | 7.5 |
| 18 | BAT52 BAT52R* | Rimless coaxial | 220–320 | 8.5 |
| 40 | BAT38 | Mixer pill | 700–1100 | 10 |
| 40 | BAT59 | Mixer pill | 700–1400 | 10 |
| 40 | BAV72 | M.Q.M. | 850–1300 | 10 |

*Reverse polarity version.

SECTION C (cont.)**Schottky Barrier Detector Diodes**

| Frequency Range (GHz) | Type No. | Description | Typ. 1/f noise (dB) | Typ. Tangential Sensitivity (dBm) |
|-----------------------|----------|----------------------|---------------------|-----------------------------------|
| 8 to 12 | BAV46 | Reversible cartridge | 10 | -55 |
| 8 to 12 | BAV75 | Pill | 10 | -50 |
| 8 to 12 | BAV97 | M.Q.M. | 10 | -54 |

Schottky Barrier Diode for Intruder Alarm Applications

| Frequency Range (GHz) | Type No. | Description | Typ. 1/f noise (μ V) | Typ. Voltage output for -90 dBm input (μ V) |
|-----------------------|----------|----------------------|---------------------------|--|
| 8 to 12 | BAV46 | Reversible cartridge | 1.0* | 40 |

*1 Hz to 1 kHz from carrier

SECTION D - BACKWARD DIODES**Backward Detector Diodes**

| Frequency Range (GHz) | Type No. | Description | Figure of merit (M) | Typ. Tangential Sensitivity (dBm) |
|-----------------------|-------------------|-----------------|---------------------|-----------------------------------|
| 1 to 18 | AEY17 | Mixer pill | >120 | -53 |
| 12 to 18 | AEY29 AEY29R** | Rimless coaxial | >50 | -53 |
| 1 to 18 | AEY31 | M.Q.M. | >120 | -53 |
| 1 to 18 | AEY31A | M.Q.M. | >50 | -50 |
| 18 to 40 | AEY32 | M.Q.M. | >50 | 2.0 μ A/ μ W† |

**Reverse polarity version

†Zero bias current sensitivity (typ.)

SECTION E – VARACTOR DIODES

Multiplier Varactor Diodes

| Capacitance min. max. (pF) | | at V_R (V) | Type No. | Description | V_R max. (V) | Typ. Cut-off Frequency (GHz) |
|----------------------------------|-----|-----------------|--------------------------------|---|----------------------|---------------------------------------|
| 0.25 | 0.5 | 6 | BXY41 | Silicon planar step recovery | 25* | 200* |
| 0.4 | 0.9 | 6 | BXY40 | | 25* | 180* |
| 0.5 | 1.0 | 6 | BXY32 | Silicon planar epitaxial step recovery. For high order frequency multiplier outputs in X-band | 20 | 150 |
| 0.6 | 1.0 | 6 | 1N5157 | Silicon planar epitaxial step recovery. For frequency multiplier outputs in X-band | 20 | 200 |
| 0.8 | 1.5 | 6 | BXY29 | | 25 | 120 |
| 0.8 | 1.2 | 6 | BXY39 | Silicon planar step recovery | 40* | 150* |
| 1.0 | 2.5 | 6 | BXY28 | Silicon planar epitaxial step recovery. For frequency multiplier outputs in C-band | 45 | 120 |
| 1.0 | 3.0 | 6 | 1N5155 | | 35 | 120 |
| 1.2 | 2.0 | 6 | BXY38 | Silicon planar step recovery | 50* | 120* |
| 1.5 | 2.5 | 6 | BXY56 | High efficiency silicon types for multipliers with output frequencies in C and X-bands | 60 | 160* |
| 2.5 | 3.5 | 6 | BXY57 | | 60 | 140* |
| 2.0 | 4.0 | 6 | BXY37 | Silicon planar step recovery | 70* | 100* |
| 3.0 | 6.0 | 6 | BXY27 | Silicon planar epitaxial step recovery. For frequency multiplier outputs in S-band | 55 | 100 |
| 4.0 | 6.0 | 6 | BXY36 | Silicon planar step recovery | 70* | 75* |
| 5.0 | 7.5 | 6 | 1N5152 1N5153 | Silicon planar epitaxial step recovery. For frequency multiplier outputs in S-band | 75 | 100 |
| 6.0 | 12 | 6 | BXY35 | Silicon planar step recovery | 100* | 25* |
| 28 | 39 | 6 | BAY96 | Silicon planar epitaxial. For high efficiency frequency multipliers | 120 | 25 |

* minimum

SECTION E (cont.)

Special Purpose Varactor Diodes

| Capacitance min. max. (pF) | | at V_R (V) | Type No. | Description | V_R max. (V) | Typ. Cut-off Frequency (GHz) |
|----------------------------------|-----|-----------------|----------|--|----------------------|---------------------------------------|
| 0.2 typ. | | 0 | CXY10 | Gallium arsenide. For parametric amplifiers, frequency multipliers and switches | 6 | 350 |
| 0.25 typ. | | 6 | CXY12 | Gallium arsenide. For frequency multiplier circuits up to Q-band output frequency | 10 | 500 |
| 0.3 | 0.5 | 0 | CAY10 | Gallium arsenide diffused mesa type. For parametric amplifiers, frequency multipliers and switches | 6 | 240 |

| Frequency Range (GHz) | Type No. | Description | Typ. Att. (dB) | Typ. Insertion Loss (dB) |
|-----------------------------|------------------|---------------------------------|----------------------|-----------------------------------|
| 2 to 7 7 to 12 | CXY22A CXY22B | Gallium arsenide limiter diodes | 20 16 | 0.2 0.3 |

Tuning Varactor Diodes

| Capacitance min. max. (pF) | | at V_R (V) | Type No. | Description | V_R max. (V) |
|----------------------------------|-----|-----------------|----------|--|----------------------|
| 0.8 | 1.2 | 4 | BXY53 | Silicon planar epitaxial tuning devices | 60 |
| 3.7 | 5.7 | 4 | BXY54 | | 60 |
| 12 | 18 | 4 | BXY55 | | 60 |
| 0.8 | 1.2 | 0 | CXY23A | Gallium arsenide Schottky barrier tuning devices | 12 |
| 1.2 | 1.8 | 0 | CXY23B | | 12 |
| 1.6 | 2.5 | 0 | CXY23C | | 12 |
| 2.5 | 3.5 | 0 | CXY23D | | 12 |

SECTION F – GUNN OSCILLATORS

This selection represents only a part of the Mullard range of solid state sources. Custombuilt sources, including some with higher output powers, are available on request. Mullard offers a comprehensive capability in the area of general solid state oscillators, with complex phase locked and frequency agile sources for military applications.

| Type No. | Nominal Centre Frequency (GHz) | P _{out} (mW) | Minimum Mechanical Tuning Range (MHz) | Minimum Electronic Tuning Range (MHz) | Output Coupling |
|-------------------|--------------------------------|-----------------------|---------------------------------------|---------------------------------------|-----------------|
| CL8310 | 9.4 | 5 | ± 50 | 200 | WG16/WR90 |
| CL8630 CL8630S | 10.687 | 8 | — | — | WG16/WR90 |
| CL8631 CL8631S | 9.35 | 8 | — | — | WG16/WR90 |
| CL8632 CL8632S | 9.47 | 8 | — | — | WG16/WR90 |
| CL8633 CL8633S | 10.525 | 8 | — | — | WG16/WR90 |
| CL8640R* | 10.49 | 6 | ±60 | 30 | WG16/WR90 |
| CL8640T† | 10.56 | 6 | ±60 | 8 | WG16/WR90 |
| CL8690** | 9.375 | 5 | ± 75 | 50 | WG16/WR90 |

* Receiver local oscillator

† Transmitter

** Klystron replacement for marine radars. Complies with B.O.T. specification BOT SBN 115 10057/1.

S following type number signifies a self-oscillating mixer (auto-detector).

SECTION G – DOPPLER AND TRAFFIC RADARS

Traffic radars

| Type No. | Description | Detection Range (metres) | A.C. Supply Voltage (V) |
|-----------|---|--------------------------|-------------------------|
| CL8880BN | X-band traffic radar sensor. Cable entry through case. | 100 | 110 |
| CL8880BNC | X-band traffic radar sensor. Cable entry through mounting foot | 100 | 110 |

Doppler modules

| Type No. | Description | Centre frequency (GHz) | Power Output typ. (mW) | Voltage Output* typ. (μ V) |
|----------|---|------------------------|------------------------|---------------------------------|
| CL8960 | Doppler modules for volumetric presence detection, industrial process control, proximity switching, intruder alarms and similar applications. | 10.687 | 10 | 40 |
| CL8961 | | 9.350 | 10 | 40 |
| CL8962 | | 9.470 | 10 | 40 |
| CL8963 | | 10.525 | 10 | 40 |
| CL8964 | | 9.900 | 10 | 40 |
| CL8965 | | 10.565 | 10 | 40 |
| CL8967 | | 10.365 | 10 | 40 |

- * Output voltage for input power 100 dB down on power output at 18 dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$

SECTION H – MISCELLANEOUS

Horn antenna

| Type No. | Description | Frequency Range (GHz) | Gain (dB) |
|----------|-----------------------------------|--------------------------|--------------|
| ACX-01A | Horn antenna for miniature radars | 9.0 to 11 | 16 |

Mixers/detectors

| Type No. | Description | Centre Frequency (GHz) | Connections |
|----------|---|---------------------------|-------------|
| CL7500 | Waveguide single ended mixers/detectors | 10.687 | WG16/WR90 |
| CL7520 | | 9.35 | WG16/WR90 |

Parametric amplifier

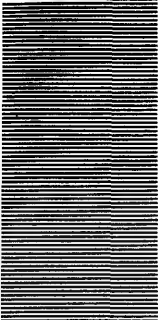
| Type No. | Description | Gain (dB) | Noise Figure max. (dB) | Bandwidth (MHz) | Frequency Range (GHz) |
|----------|--|--------------|---------------------------------|--------------------|-----------------------------|
| CL9022 | Packaged parametric amplifier in temperature stabilized enclosure | 20 | 2.8 | 15 | 2.7 to 3.1 |

SECTION J – ISOLATORS AND CIRCULATORS

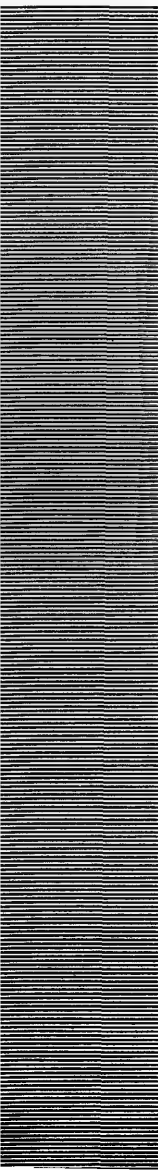
See selection guide in section J

GENERAL SECTION

A



A



MICROWAVE SEMICONDUCTORS GENERAL EXPLANATORY NOTES

TYPE NOMENCLATURE

Mullard microwave semiconductor devices are registered with Pro-Electron.

The type nomenclature of a discrete device or, in certain cases, of a range of devices, consists of three letters followed by a serial number. The serial number normally consists of two figures, but a suffix letter is added where variants or a series occur.

The first letter indicates the semiconductor material used:

- A - germanium
- B - silicon
- C - compound materials, such as gallium arsenide

The second letter indicates the general function of the device:

- A - detection diode, mixer diode
- E - backward diode
- X - multiplier diode such as varactor or step recovery diode

The third letter is T, V, W, X or Y which indicates that the device is designed or developed for industrial, professional or transmitting applications.

Subscripts for quantity symbols

- A, a anode terminal
- BR breakdown
- F, f forward
- I, i input
- J, j junction
- K, k cathode
- O, o open-circuit, output
- R, r resistive, reverse, repetitive
- S, s series, source
- Z, z impedance



ELECTRICAL PARAMETERS

| | Device | Associated circuit |
|-------------------|----------------------|--------------------|
| Resistance | r | R |
| Reactance | x | X |
| Impedance | z | Z |
| Admittance | y | Y |
| Conductance | g | G |
| Susceptance | b | B |
| Mutual inductance | m | M |
| Inductance | l | L |
| Capacitance | c | C |
| Frequency limits | f max. f min. | |
| Bandwidth | Δf | B |
| Noise factor | | N |

Symbols for microwave semiconductor devices

| | |
|-----------|---|
| η | efficiency |
| B | bandwidth |
| C_d | diode capacitance |
| C_j | junction capacitance |
| C_{min} | diode capacitance at breakdown voltage |
| C_o | diode capacitance at zero bias |
| C_p | parasitic (parallel) capacitance |
| C_s | stray capacitance |
| C_{tot} | total capacitance |
| f | operating frequency |
| f_{co} | varactor diode cut-off frequency |
| I | current |
| I_{dc} | bias current |
| i.f. | intermediate frequency |
| I_F | d.c. forward current |
| I_{FM} | peak forward current |
| I_R | continuous (d.c.) reverse leakage current |
| L_c | conversion loss |
| L_s | series inductance |
| M | figure of merit |
| N_f | flicker noise |
| N_{if} | noise figure at intermediate frequency |



| | |
|-------------|--|
| N_o | overall noise figure |
| N_r | noise temperature ratio |
| P_{in} | input r.f. power |
| P_{out} | output r.f. power |
| P_{tot} | total power dissipated within the device |
| R_L | r.f. load resistance |
| R_s | spreading resistance |
| R_{th} | thermal resistance |
| S_i | current sensitivity |
| S_{ts} | tangential sensitivity |
| T_{amb} | ambient temperature |
| T_{case} | case temperature |
| T_{hs} | heatsink temperature at device interface with device |
| T_j | junction temperature |
| T_{stg} | storage temperature |
| t_p | pulse duration |
| t_s | storage time |
| t_{tr} | transition time |
| V | voltage |
| V_{BR} | breakdown voltage |
| $V_{(BR)R}$ | reverse breakdown voltage |
| V_F | d.c. forward voltage |
| V_R | d.c. reverse voltage |
| $v.s.w.r.$ | voltage standing wave ratio |
| Z_{if} | intermediate frequency impedance |
| Z_{rf} | radio frequency impedance |
| Z_v | video impedance |
| $1/f$ | flicker noise |

PRODUCT SAFETY

The most modern high technology materials have been used in these components to ensure the highest performance for the user. Some of them are toxic to man but the quantity used in a single device is so small that the risk of toxic effects are negligible even in extreme circumstances.



EXPLANATION OF HANDBOOK DATA

1. FORM OF ISSUE

The semiconductor data published in the Handbook follows the same pattern, as much as possible, concerning, (a) the forms of issue, (b) the ratings system and (c) the ratings presentation.

1.1 Types of Data

The Handbook data is published either as tentative or final data.

Tentative Data

Tentative data aims at providing information on new devices as early as possible to allow the customer to proceed with circuit design. The tentative data may not include all the characteristics or ratings which will be incorporated later in the final data and some of the numerical values quoted may be slightly adjusted later on.

Final Data

The transfer from tentative data to final data involves the addition of those numerical values and curves which were not available at tentative data stage and small adjustments to those values already quoted in tentative data. Reissue of final data may be made from time to time to incorporate additional information resulting from prolonged production experience or to meet new applications.

1.2 Presentation of Data

The information on the published data sheets is presented in the following form:

- description of basic application and physical characteristics of the device.
- quick reference data giving the most important ratings and characteristics.
- outline and dimensions. Reference to standard outline nomenclature if applicable and lead connections.
- Ratings. Voltage, current, power and thermal ratings.
- Characteristics.
- Application information or operating conditions.
- Mechanical and environmental data if applicable.
- Charts showing ratings and characteristics.

2. RATINGS

A rating is a limiting condition of usage specified for a device by the manufacturer, beyond which the serviceability may be impaired.

A rating system is a set of principles upon which ratings are established and which determines their interpretation. There are three systems which have been internationally accepted and which allocate responsibility between the device manufacturer and the circuit designer differently.

2.1 Rating Systems

Unless otherwise stated the ratings given in semiconductor data sheets follow the absolute maximum rating system.

The definitions of the three systems accepted by the International Electro-technical Commission are as follows:

ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any device of a specified type as defined by the published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for variations in equipment or environment, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other devices in the equipment.

The equipment manufacturer should design so that initially and throughout life no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to variations in supply voltage, environment, equipment components, equipment control adjustment, load, signal or characteristics of the device under consideration and of all other devices in the equipment.

DESIGN-CENTRE RATING SYSTEM

Design-centre ratings are limiting values of operating and environmental conditions applicable to a bogey device of a specified type as defined by its published data, and should not be exceeded under normal conditions. These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to variations in supply voltage, environment, equipment components, equipment control adjustment, load, signal or characteristics of all other devices in the equipment. The equipment manufacturer should design so that initially no design-centre value for the intended service is exceeded with a bogey device in equipment operating at the stated normal supply voltage.

DESIGN-MAXIMUM RATING SYSTEM

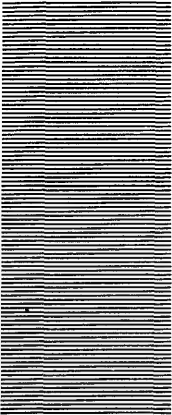
Design-maximum ratings are limiting values of operating and environmental conditions applicable to a bogey device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the device under consideration.

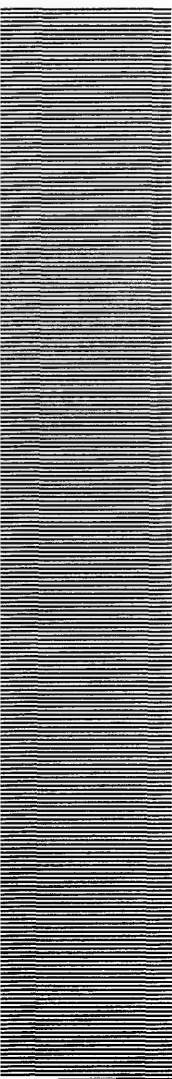
The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to variations in supply voltage, environment, equipment components, equipment control adjustment, load, signal or characteristics of the device under consideration and of all other devices in the equipment.

GUNN, IMPATT AND NOISE DIODES

B



B



SILICON AVALANCHE NOISE DIODE

BAT31

Epitaxial, silicon planar, broadband noise generator. This is a current controlled device operated at avalanche breakdown and is effective from less than 10 Hz to above J-band. Applications include built-in test equipment (BITE) for surveillance, tracking and weather radars, microwave links, direction finding, p.c.m. systems and noise modulators for electronic countermeasures.

It conforms to the environmental requirements of BS9300 where applicable.

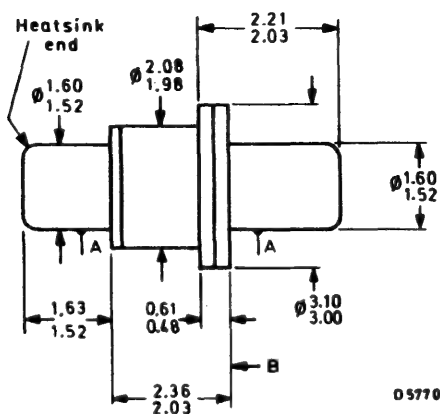
QUICK REFERENCE DATA

| | |
|---------------------------------------|------------------------|
| Frequency range | <10 Hz to >18 GHz |
| Avalanche voltage | min. 17 V max. 22 V |
| Recommended operating current range | 0.5 to 40 mA |
| Broadband excess noise ratio (fig. 3) | typ. 34 dB |

OUTLINE AND DIMENSIONS

Dimensions in mm

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13



Normal operation with reverse bias, i.e. heatsink end positive.

LIMITING VALUES (Absolute max. rating system)

| | | | |
|-----------------|------|-------------|----|
| I_R | max. | 40 | mA |
| P_{tot} | max. | 1.0 | W |
| T_{mb} | max. | 80 | °C |
| T_{stg} range | | -55 to +150 | °C |

CHARACTERISTICS ($T_{mb} = 25^\circ\text{C}$)

| | | | |
|--|------|-----|---------------|
| $V_{BR(R)}$ at $I_R = 5\text{ mA}$ | min. | 17 | V |
| C_j at $V_R = 6\text{ V}$, $f = 1\text{ MHz}$ | min. | 0.4 | pF |
| | max. | 0.8 | pF |
| I_R at $V_R = 6\text{ V}$ | max. | 0.1 | μA |
| R_{slope} at $I_R = 40\text{ mA}$, $f = 1\text{ kHz}$ 1) | max. | 60 | Ω |
| $\frac{R_1}{R_{40}}$ at $I_R = 1\text{ mA}$ and 40 mA , $f = 1\text{ kHz}$ 1) | max. | 2.5 | |
| C_s | typ. | 0.2 | pF |
| L_S | typ. | 650 | pH |

- 1) R_{slope} is the reverse slope resistance and $\frac{R_1}{R_{40}}$ is the ratio of reverse slope resistance at 1 mA and 40 mA, measured at 1 kHz. This ratio is included in the characteristics to eliminate spurious effects in the noise output/current characteristic. The reverse slope resistance consists of the space charge resistance R_{sc} , the spreading resistance R_{sp} and the 'thermal resistance' R_{th} , i.e.

$$R_{slope} = R_{sc} + R_{sp} + R_{th}$$

where: R_{sc} is approximately 10 Ω at 10 to 40 mA and 19 Ω at 1 mA

R_{sp} is approximately 1 Ω

R_{th} is the effective resistance due to isothermal heating in the device when operated with an infinite heatsink. Above 10 MHz, R_{th} may be neglected.

- 2) The location of the top cap should be a hole of diameter 1.8 to 2.2 mm, bearing on flange with a force not exceeding 10 N.
- 3) Other encapsulations may be made available on request.

APPLICATION INFORMATION

The device, as characterized, is operated in a 50 Ω characteristic impedance measurement system. When used as a noise source in an on-off mode, the device, when off, should appear to be 50 Ω . Since it has a large reflection coefficient when zero biased or biased just below avalanche breakdown, sufficient attenuation is required to provide a reasonable match to 50 Ω . For the broadest operating frequency range, an attenuator of approximately 14 dB with a v.s.w.r. of <1.2:1 is recommended. This will reduce the available excess noise by 14 dB. Higher excess noise may be obtained, but over a reduced operating frequency range, in a balanced configuration with low noise directional couplers (e.g. a 3 dB quadrature coupler), or fed into a broadband ferrite isolator (or terminated circulator) which would reduce the available excess noise by approximately 1 dB.

Temperature and excess noise relationship

| Excess noise dB | Noise temperature oK | 1 Hz bandwidth dBm | 1 MHz bandwidth dBm |
|--------------------|-------------------------|-----------------------|------------------------|
| +100 | 2.9×10^{12} | - 74 | - 14 |
| + 90 | 2.9×10^{11} | - 84 | - 24 |
| + 80 | 2.9×10^{10} | - 94 | - 34 |
| + 70 | 2.9×10^9 | -104 | - 44 |
| + 60 | 2.9×10^8 | -114 | - 54 |
| + 50 | 2.9×10^7 | -124 | - 64 |
| + 40 | 2.9×10^6 | -134 | - 74 |
| + 30 | 2.9×10^5 | -144 | - 84 |
| + 20 | 2.9×10^4 | -154 | - 94 |
| + 10 | 2.9×10^3 | -164 | -104 |
| 0 | 2.9×10^2 | -174 | -114 |

The device may be pulse operated with a rise time of $\ll 0.5 \mu\text{s}$

The device should be operated from a constant current source, however, good results may be achieved using a 28 V supply and typically a metal film or wirewound 1.6 k Ω resistor in series with the noise diode, with suitable power supply decoupling.

In some applications, current profiling with time may be useful, i.e. linear excess noise ratio as a function of log bias current as shown in fig. 1. This may be used for receiver sensitivity measurement on a P.P.I. display.

— Recommended bias range for broadband operation up to 12.4GHz

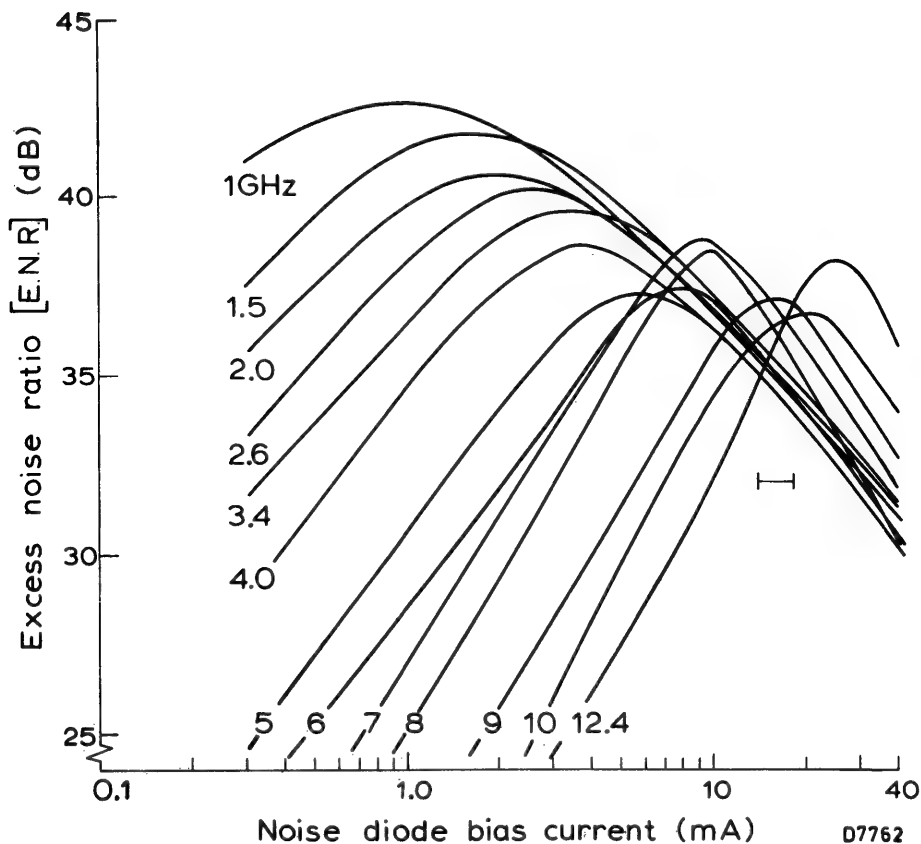
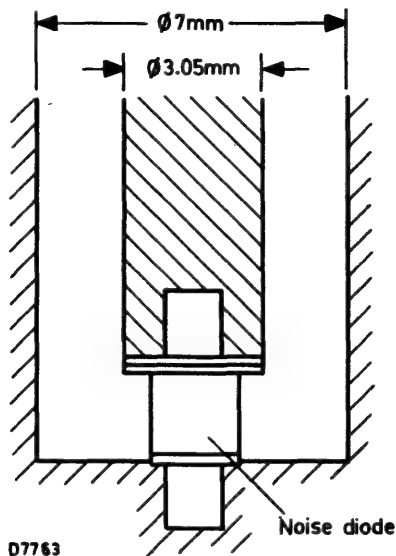


Fig. 1

Typical excess noise ratio as a function of avalanche current with frequency as a parameter.
Device mounted in a 50 Ω 7 mm coaxial line as shown in Fig. 2



D7763

Fig. 2

Device mounted in a 50 Ω 7 mm coaxial line

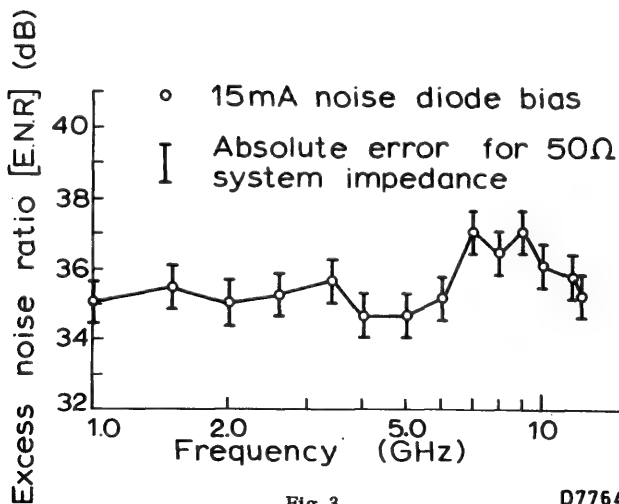


Fig. 3

D7764

Typical broadband noise performance for an avalanche current of 15 mA
with device mounted as shown in Fig. 2

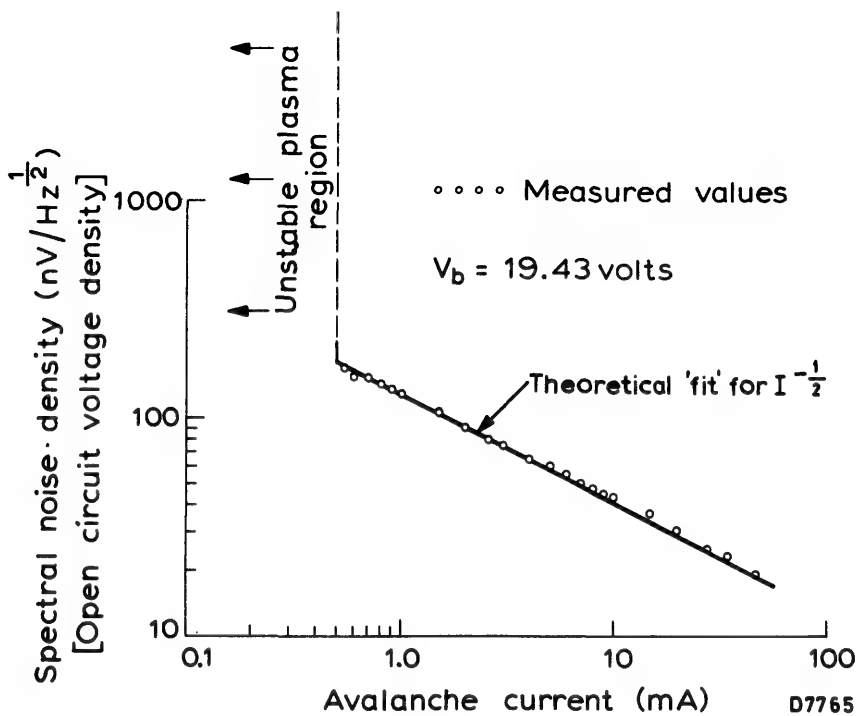


Fig. 4

Typical broadband noise density measured over a 1 kHz to 10 kHz bandwidth.

SILICON IMPATT DIODE

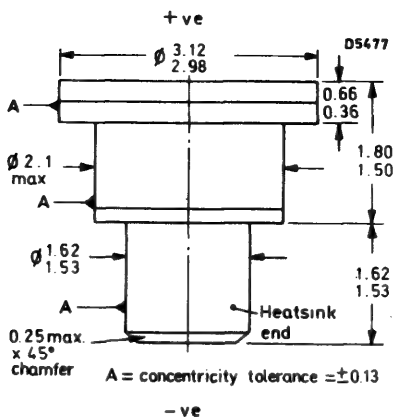
BXY50

A high efficiency silicon Impatt diode for the generation of c.w. power at micro-wave frequencies. It conforms to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA

| | | |
|--|-----------|-----|
| Operating frequency | 8.0 to 10 | GHz |
| P_{out} (typ.) ($T_{hs} = 35^{\circ}\text{C}$) | 600 | mW |
| Operating current (typ.) | 135 | mA |
| Operating voltage (typ.) | 91 | V |

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--------------------------------------|---|----------------------|
| P_{tot} max. (see note 1) | $\frac{200 - T_{\text{hs}}}{R_{\text{th}} (j - \text{hs})}$ | W |
| $R_{\text{th}} (j - \text{hs})$ max. | 15 | $^{\circ}\text{C/W}$ |
| $T_j - T_{\text{hs}}$ max. | 165 | $^{\circ}\text{C}$ |
| T_{stg} range | -55 to +175 | $^{\circ}\text{C}$ |

ELECTRICAL CHARACTERISTICS ($T_{\text{hs}} = 25^{\circ}\text{C}$)

| | Min. | Typ. | Max. | |
|---------------------------|------|------|------|--|
| $V_{(\text{BR})\text{R}}$ | | | | Reverse breakdown voltage (at $I_{\text{R}} = 1.0\text{mA}$) |
| | 65 | 75 | 85 | V |
| I_{R} | | | | Reverse current (at $V_{\text{R}} = 50\text{V}$) |
| | - | - | 10 | μA |
| C_{T} | | | | Total capacitance (at $V_{(\text{BR})\text{R}} = 5\text{V}$) |
| | - | 0.9 | - | pF |

TYPICAL OSCILLATOR PERFORMANCE

| | | | | |
|--|-----|-----|----|-----|
| Operating current (see note 2) | | 135 | | mA |
| Operating voltage | | 91 | | V |
| Frequency (see note 3) | 8.0 | - | 10 | GHz |
| Output power (see notes 2, 4, 5 and 6) | 500 | 600 | - | mW |
| Efficiency | - | 5.0 | - | % |

OPERATING NOTES

- The maximum junction temperature is 200°C , therefore care must be taken to ensure that $P_{\text{tot}} \text{ max.} \leq \frac{200 - T_{\text{hs}}}{R_{\text{th}} (j - \text{hs})} \text{ W}$,

where $P_{\text{tot}} = P_{\text{in}} - P_{\text{out}}$

T_{hs} = temperature of heatsink at interface with device

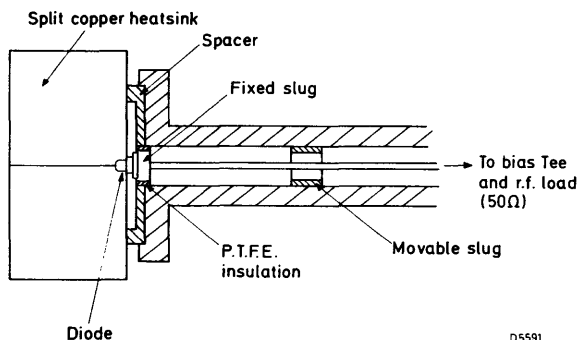
$R_{\text{th}} (j - \text{hs})$ = thermal resistance from junction to heatsink in which device is clamped.

- The bias supply should be current regulated to within 1% and care should be taken to avoid transient current surges which could cause burnout. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. The maximum power supply requirements are 115V and 160mA.
- The frequency is governed by the choice of cavity to which the device is coupled.
- The polarity of the device must be strictly observed when applying bias, (see outline drawing).
- The output power is normally measured in a coaxial cavity near to centre band frequency.

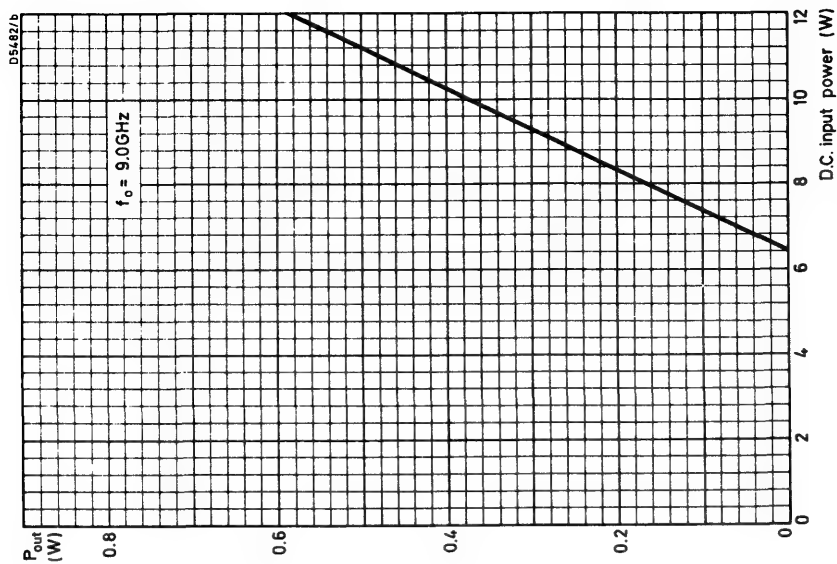
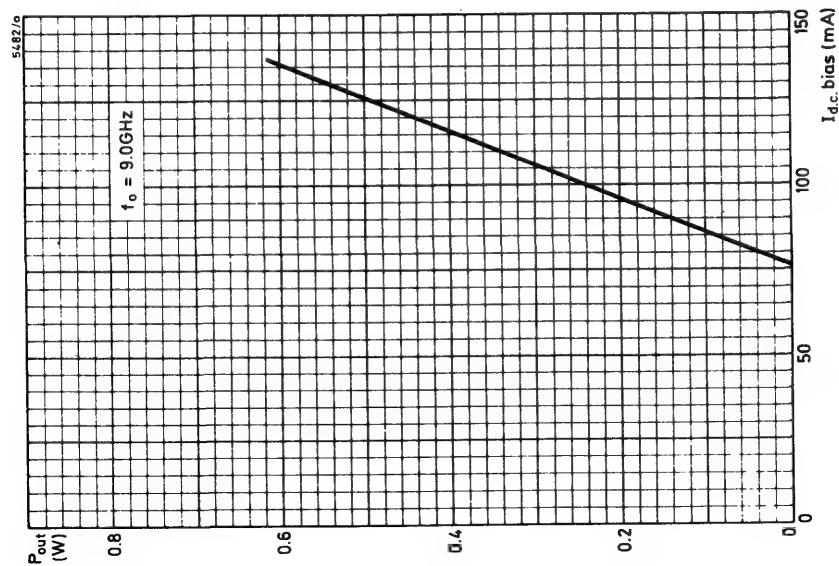
OPERATING NOTES (contd.)

6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive single loaded epoxy, such as Epotek H40, may be used.
7. This device may be used as a negative resistance amplifier.

Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT

TYPICAL OUTPUT POWER AS A FUNCTION OF D. C. INPUT POWER

SILICON IMPATT DIODE

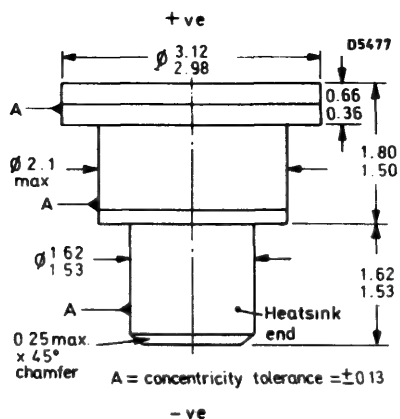
BXY51

A high efficiency silicon Impatt diode for the generation of c.w. power at micro-wave frequencies. It conforms to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA

| | | |
|--|----------|-----|
| Operating frequency | 10 to 12 | GHz |
| P_{out} (typ.) ($T_{hs} = 35^{\circ}\text{C}$) | 450 | mW |
| Operating current (typ.) | 120 | mA |
| Operating voltage (typ.) | 80 | V |

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--------------------------------------|---|-----------------------------|
| P_{tot} max. (see note 1) | $\frac{200 - T_{\text{hs}}}{R_{\text{th}} (j - \text{hs})}$ | W |
| $R_{\text{th}} (j - \text{hs})$ max. | 19 | $^{\circ}\text{C}/\text{W}$ |
| $T_j - T_{\text{hs}}$ max. | 165 | $^{\circ}\text{C}$ |
| T_{stg} range | -55 to +175 | $^{\circ}\text{C}$ |

ELECTRICAL CHARACTERISTICS ($T_{\text{hs}} = 25^{\circ}\text{C}$)

| | Min. | Typ. | Max. | |
|--|------|------|------|---------------|
| $V_{(\text{BR})\text{R}}$ Reverse breakdown voltage (at $I_{\text{R}} = 1.0\text{mA}$) | 55 | 65 | 75 | V |
| I_{R} Reverse current (at $V_{\text{R}} = 45\text{V}$) | - | - | 10 | μA |
| C_{T} Total capacitance (at $V_{(\text{BR})\text{R}} - 5\text{V}$) | - | 0.85 | - | pF |

TYPICAL OSCILLATOR PERFORMANCE

| | | | | |
|--|-----|-----|----|-----|
| Operating current (see note 2) | | 120 | | mA |
| Operating voltage | | 80 | | V |
| Frequency (see note 3) | 10 | - | 12 | GHz |
| Output power (see notes 2, 4, 5 and 6) | 400 | 450 | - | mW |
| Efficiency | - | 5.0 | - | % |

OPERATING NOTES

1. The maximum junction temperature is 200°C , therefore care must be taken to ensure that $P_{\text{tot}} \text{ max.} \leq \frac{200 - T_{\text{hs}}}{R_{\text{th}} (j - \text{hs})} \text{ W}$,

$$\text{where } P_{\text{tot}} = P_{\text{in}} - P_{\text{out}}$$

T_{hs} = temperature of heatsink at interface with device

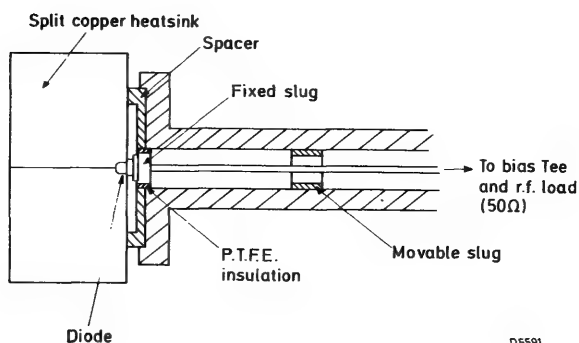
$R_{\text{th}} (j - \text{hs})$ = thermal resistance from junction to heatsink in which device is clamped.

2. The bias supply should be current regulated to within 1% and care should be taken to avoid transient current surges which could cause burnout. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 105V and 170mA.
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

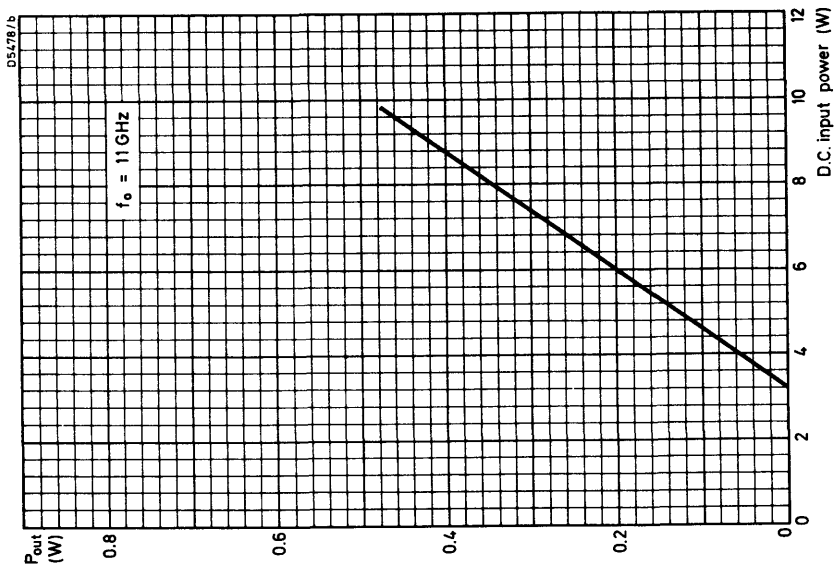
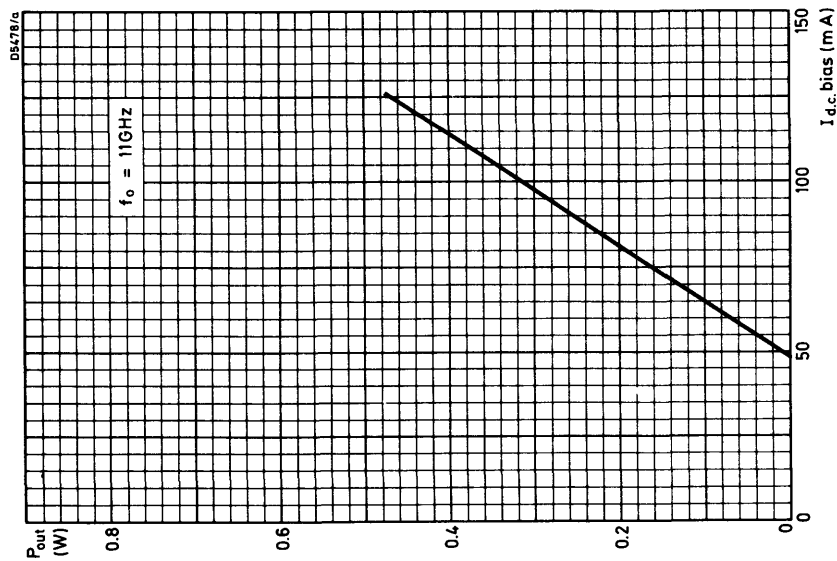
OPERATING NOTES (contd.)

6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive single loaded epoxy, such as Epotek H40, may be used.
7. This device may be used as a negative resistance amplifier.

Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT TYPICAL OUTPUT POWER AS A FUNCTION OF D. C. INPUT POWER

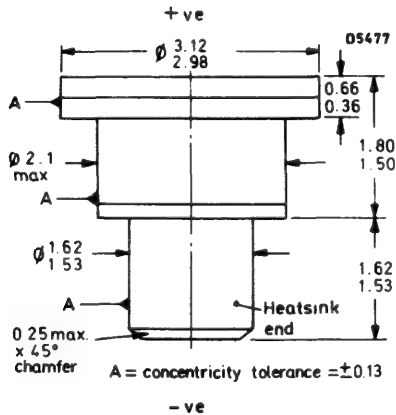
**SILICON IMPATT
DIODE**

BXY52

A high efficiency silicon Impatt diode for the generation of c.w. power at micro-wave frequencies. It conforms to the environmental requirements of BS 9300 where applicable.

| QUICK REFERENCE DATA | | |
|--|----------|-----|
| Operating frequency | 12 to 14 | GHz |
| P _{out} (typ.) (T _{hs} = 35°C) | 370 | mW |
| Operating current (typ.) | 120 | mA |
| Operating voltage (typ.) | 70 | V |

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--------------------------------------|---|----------------------|
| P_{tot} max. (see note 1) | $\frac{200 - T_{\text{hs}}}{R_{\text{th}} (j - \text{hs})}$ | W |
| $R_{\text{th}} (j - \text{hs})$ max. | 24 | $^{\circ}\text{C/W}$ |
| $T_j - T_{\text{hs}}$ max. | 165 | $^{\circ}\text{C}$ |
| T_{stg} range | -55 to +175 | $^{\circ}\text{C}$ |

ELECTRICAL CHARACTERISTICS ($T_{\text{hs}} = 25^{\circ}\text{C}$)

| | Min. | Typ. | Max. | |
|---|------|------|------|---------------|
| $V_{\text{(BR)R}}$ Reverse breakdown voltage (at $I_{\text{R}} = 1.0\text{mA}$) | 50 | 55 | 60 | V |
| I_{R} Reverse current (at $V_{\text{R}} = 40\text{V}$) | - | - | 10 | μA |
| C_{T} Total capacitance (at $V_{\text{(BR)R}} = -5\text{V}$) | - | 0.75 | - | pF |

TYPICAL OSCILLATOR PERFORMANCE

| | | | | |
|--|-----|-----|----|-----|
| Operating current (see note 2) | | 120 | | mA |
| Operating voltage | | 70 | | V |
| Frequency (see note 3) | 12 | | 14 | GHz |
| Output power (see notes 2, 4, 5 and 6) | 300 | 370 | - | mW |
| Efficiency | - | 4.5 | - | % |

OPERATING NOTES

1. The maximum junction temperature is 200°C , therefore care must be taken to ensure than P_{tot} max. $\leq \frac{200 - T_{\text{hs}}}{R_{\text{th}} (j - \text{hs})}$ W,

$$\text{where } P_{\text{tot}} = P_{\text{in}} - P_{\text{out}}$$

T_{hs} = temperature of heatsink at interface with device

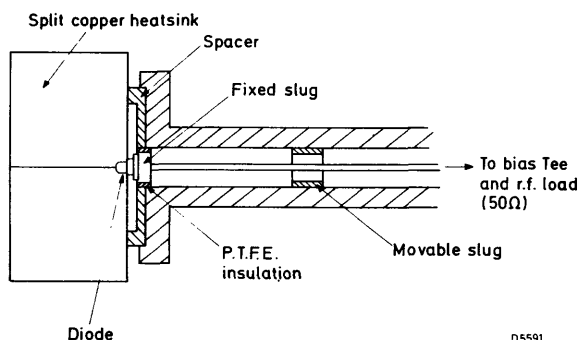
$R_{\text{th}} (j - \text{hs})$ = thermal resistance from junction to heatsink in which device is clamped.

2. The bias supply should be current regulated to within 1% and care should be taken to avoid transient current surges which could cause burnout. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitance across the diode. The maximum power supply requirements are 90V and 150mA.
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The polarity of the device must be strictly observed when applying bias, (see outline drawing).
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

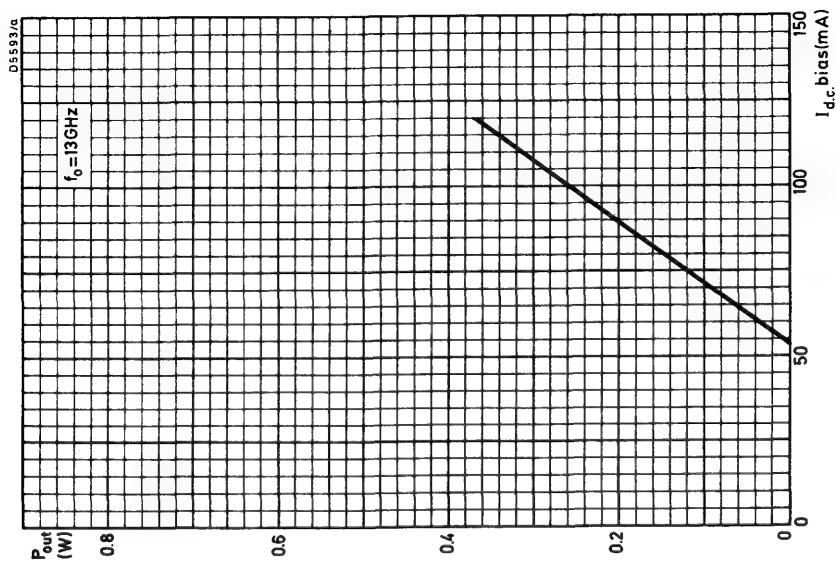
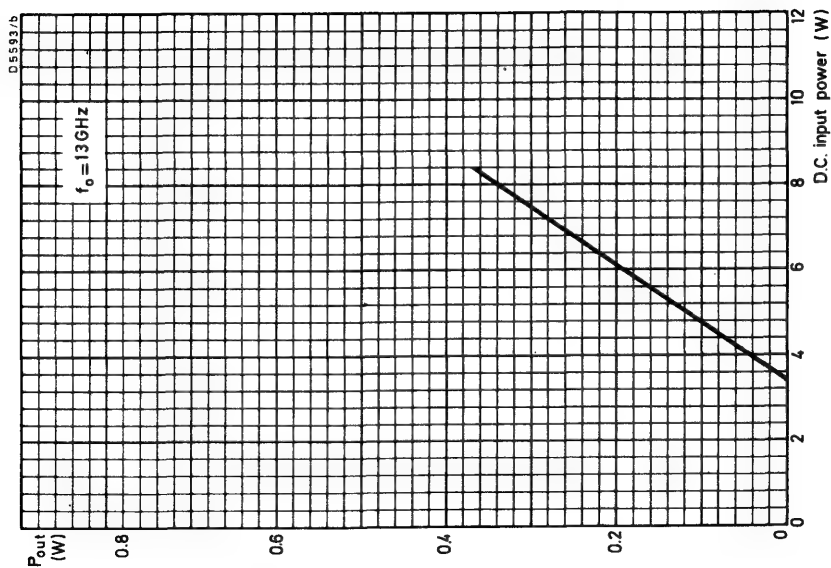
OPERATING NOTES (contd.)

6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive single loaded epoxy, such as Epotek H40, may be used.
7. This device may be used as a negative resistance amplifier.

Devices may be selected to suit customers' specific requirements



COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF D. C. INPUT POWER

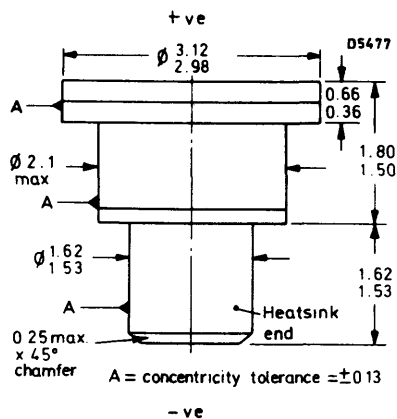
TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT

A high efficiency silicon Impatt diode for the generation of c.w. power at micro-wave frequencies. It conforms to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA

| | | |
|---|------------|-----|
| Operating frequency | 6.0 to 8.0 | GHz |
| P_{out} (typ.) ($T_{hs} = 35^{\circ}C$) | 750 | mW |
| Operating current (typ.) | 125 | mA |
| Operating voltage (typ.) | 120 | V |

OUTLINE AND DIMENSIONS



All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--------------------------------------|---|-----------------------------|
| P_{tot} max. (see note 1) | $\frac{200 - T_{\text{hs}}}{R_{\text{th}} (j - \text{hs})}$ | W |
| $R_{\text{th}} (j - \text{hs})$ max. | 14 | $^{\circ}\text{C}/\text{W}$ |
| $T_j - T_{\text{hs}}$ max. | 165 | $^{\circ}\text{C}$ |
| T_j max. | 200 | $^{\circ}\text{C}$ |
| T_{stg} range | -55 to +175 | $^{\circ}\text{C}$ |

ELECTRICAL CHARACTERISTICS ($T_{\text{hs}} = 25^{\circ}\text{C}$)

| | Min. | Typ. | Max. | |
|--|------|------|------|---------------|
| $V_{(\text{BR})\text{R}}$ Reverse breakdown voltage (at $I_{\text{R}} = 5.0\text{mA}$) | 85 | 100 | 115 | V |
| I_{R} Reverse current (at $V_{\text{R}} = 70\text{V}$) | - | - | 10 | μA |
| C_{T} Total capacitance (at $V_{(\text{BR})\text{R}} = 75\text{V}$) | - | 0.97 | - | pF |
| Operating current (see note 2) | | 125 | | mA |
| Operating voltage | | 120 | | V |
| Frequency (see note 3) | 6.0 | - | 8.0 | GHz |
| Output power (see notes 2, 4, 5 and 6) | 650 | 750 | - | mW |
| Efficiency | - | 5.0 | - | % |

OPERATING NOTES

1. The maximum junction temperature is 200°C , therefore care must be taken to

$$\text{ensure that } P_{\text{tot}} \text{ max.} \leq \frac{200 - T_{\text{hs}}}{R_{\text{th}} (j - \text{hs})} \text{ W,}$$

$$\text{where } P_{\text{tot}} = P_{\text{in}} - P_{\text{out}}$$

T_{hs} = temperature of heatsink at interface with device

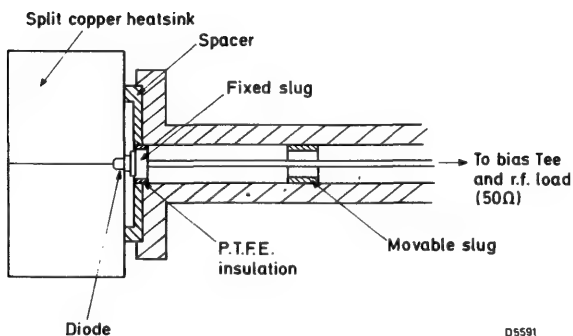
$R_{\text{th}} (j - \text{hs})$ = thermal resistance from junction to heatsink in which device is clamped.

2. The bias supply should be current regulated to within 1% and care should be taken to avoid transient current surges which could cause burnout. The bias circuit should be arranged to present a high impedance at d.c. to v.h.f. frequencies. This will help to prevent oscillation in the bias circuit and noisy operation. Particular care should be taken to minimise stray capacitances across the diode. The maximum power supply requirements are 140V and 180mA.
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The polarity of the device must be strictly observed when applying bias (see outline drawing).
5. The output power is normally measured in a coaxial cavity near to centre band frequency.

OPERATING NOTES (contd.)

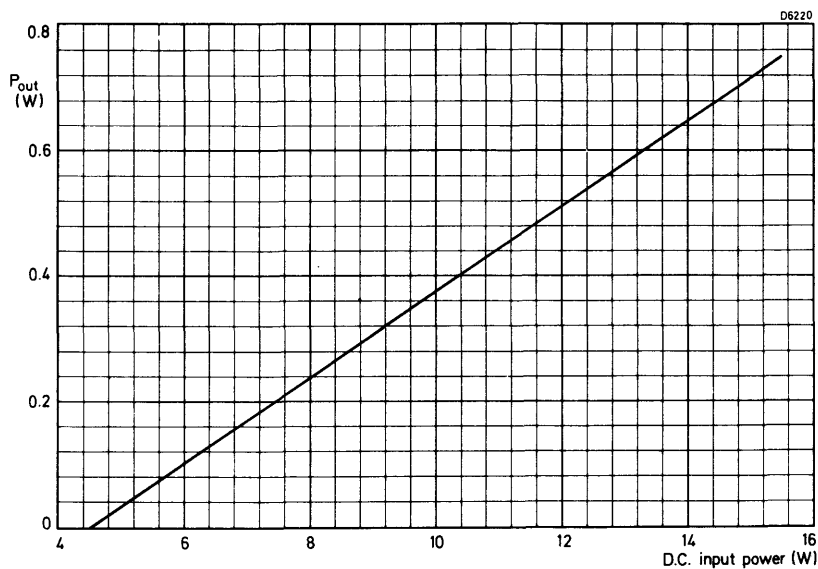
6. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive single loaded epoxy, such as Epotek H40, may be used.
7. This device may be used as a negative resistance amplifier.

Devices may be selected to suit customers' specific requirements

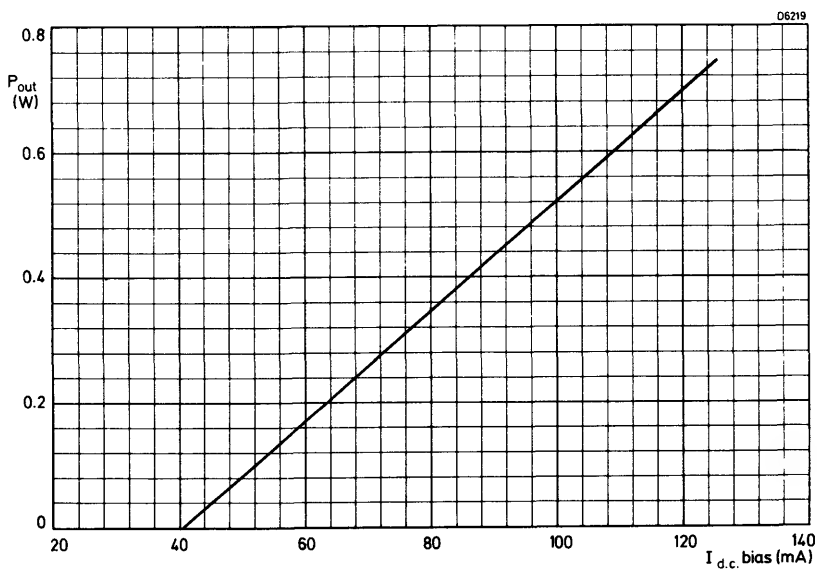


D5591

COAXIAL TEST OSCILLATOR CAVITY



TYPICAL OUTPUT POWER AS A FUNCTION OF D.C. INPUT POWER



TYPICAL OUTPUT POWER AS A FUNCTION OF BIAS CURRENT

GUNN EFFECT DEVICES

CXY11A
CXY11B
CXY11C

Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

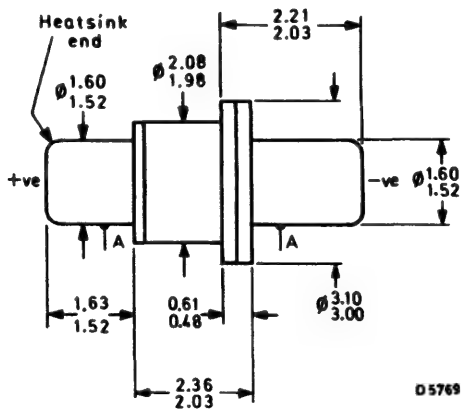
QUICK REFERENCE DATA

| | | |
|--|-----------|--------|
| Operating voltage (typ.) | 7.0 | V |
| $P_{\text{tot max.}}$ ($T_{\text{mb}} = 70^{\circ}\text{C}$) | 1.0 | W |
| Operating frequency | 8.0 to 12 | GHz |
| $P_{\text{out min.}}$ | CXY11A | 5.0 mW |
| | CXY11B | 10 mW |
| | CXY11C | 15 mW |

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|-------------|----|
| V max. ¹⁾ | 7.5 | V |
| V max (for less than 1 ms) | 9.0 | V |
| P _{tot} max. (T _{mb} = 70 °C) | 1.0 | W |
| Temperature | | |
| T _{mb} range | -40 to +70 | °C |
| T _{stg} range | -55 to +150 | °C |

→ ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

| | | Min. | Typ. | Max. | |
|--|--------|------|------|------|-----|
| I _{dc} (at V = 7.0 V) ¹⁾ | | - | 120 | 150 | mA |
| Frequency ²⁾ | | 8.0 | 9.5 | 12 | GHz |
| P _{out} (at V = 7.0 V) ³⁾ | CXY11A | 5.0 | 8.0 | - | mW |
| | CXY11B | 10 | 12 | - | mW |
| | CXY11C | 15 | 20 | - | mW |
| A.M. noise to output power ratio ⁴⁾ | | -90 | -100 | - | dB |

OPERATING NOTES

- 1) Bias must be applied in such a way that the mounting base (heatsink end) of the device is always positive. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients. An 8.2 V voltage regulator diode to shunt the power supply is recommended for this purpose.
- 2) The frequency is governed by the choice of cavity to which the device is coupled.
- 3) The output power is normally measured in a coaxial cavity at a frequency of 9.5 GHz. Other centre frequencies may be supplied at 8.5, 10.5 and 11.5 GHz by suffixing the type number e.g. CXY11B/10.5 specifies a diode giving 10 mW min. at 10.5 GHz. See the table below.
Diodes with these other centre frequencies will not necessarily oscillate over the whole 8 to 12 GHz range.
The bias may be optimized to give maximum output power within the V max. and P_{tot} max. ratings.
- 4) A.M. noise is measured in a 1 Hz to 1 kHz bandwidth with the diode mounted in a CL8630 oscillator.
- 5) It is important to ensure good thermal contact between the device and the mounting base, which in turn should be coupled to an adequate heatsink.
- 6) The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

| Minimum output power (mW) | Test Frequency (GHz) | | | |
|---------------------------|----------------------|--------|-------------|-------------|
| | 8.5 | 9.5 | 10.5 | 11.5 |
| 5 | CXY11A/8.5 | CXY11A | CXY11A/10.5 | CXY11A/11.5 |
| 10 | CXY11B/8.5 | CXY11B | CXY11B/10.5 | CXY11B/11.5 |
| 15 | CXY11C/8.5 | CXY11C | CXY11C/10.5 | CXY11C/11.5 |

Complete oscillators using these devices are obtainable from Mullard Ltd.,
Devices may be selected to suit customers' specific requirements.

Mullard

GUNN EFFECT DEVICES

CXY14A
CXY14B
CXY14C

Gallium arsenide bulk effect device employing the Gunn effect to produce c.w. ← oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

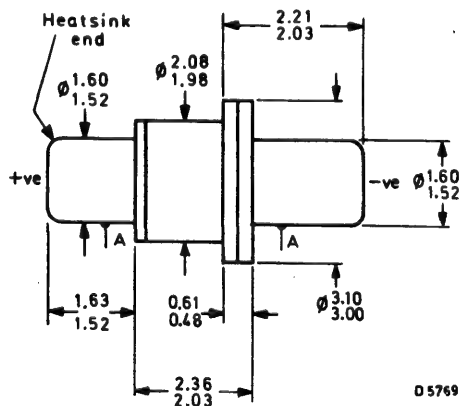
QUICK REFERENCE DATA

| | | |
|--|----------|---------|
| Operating voltage | 7.0 | V |
| $P_{\text{tot max.}}$ ($T_{\text{mb}} = 70^{\circ}\text{C}$) | 1.0 | W |
| Operating frequency | 12 to 18 | GHz |
| $P_{\text{out min.}}$ | CXY14A | 5.0 mW |
| | CXY14B | 10.0 mW |
| | CXY14C | 15.0 mW |

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|-------------|----|
| V max. (d.c.) | 7.5 | V |
| V max. (for less than 1 ms) | 9.0 | V |
| P _{tot} max. (T _{mb} = 70 °C) | 1.0 | W |
| Temperature | | |
| T _{mb} range | -40 to +70 | °C |
| T _{stg} range | -55 to +150 | °C |

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

| | | Min. | Typ. | Max. | |
|---|--------|------|------|------|-----|
| I _{dc} (at V = 7.0 V) ¹⁾ | | - | 120 | 145 | mA |
| Frequency ²⁾ | | 12 | 14 | 18 | GHz |
| P _{out} (at V = 7.0 V) ³⁾ | CXY14A | 5.0 | 8.0 | - | mW |
| | CXY14B | 10 | 12 | - | mW |
| | CXY14C | 15 | 20 | - | mW |

OPERATING NOTES

- 1) Bias must be applied in such a way that the mounting base (heatsink end) of the device is always positive. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients. An 8.2 V voltage regulator diode to shunt the power supply is recommended for this purpose.
- 2) The frequency is governed by the choice of cavity to which the device is coupled.
- 3) The output power is normally measured in a coaxial cavity at approximately centre-band frequency. The bias may be optimized to give maximum output power within the V max. and P_{tot} max. ratings.
- 4) It is important to ensure good thermal contact between the device and the mounting base, which in turn should be coupled to an adequate heatsink.
- 5) The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

| |
|---|
| <p>Devices may be selected to suit customers' specific requirements</p> |
|---|

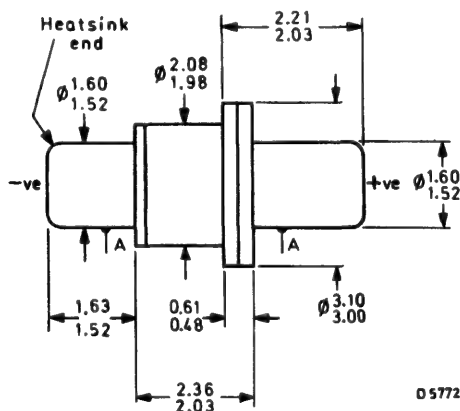
Gallium arsenide bulk effect device employing the Gunn effect to produce c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

| | | |
|--|---------|-----|
| Operating voltage (note 2) | 8 to 15 | V |
| $P_{\text{tot max.}}$ ($T_{\text{mb}} = 70^{\circ}\text{C}$) | 6.0 | W |
| Operating frequency | 8 to 12 | GHz |
| $P_{\text{out min.}}$ ($f = 9.5 \text{ GHz}$) | 100 | mW |

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--|-------------|----|
| V max. (see note 1) | 15 | V |
| P _{tot} max. (T _{mb} = 70°C) | 6.0 | W |
| Temperature | | |
| T _{mb} range | -40 to +70 | °C |
| T _{stg} range | -55 to +150 | °C |

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

| | Min. | Typ. | Max. | |
|---|------|------|------|-----|
| I _{dc} (at V = 12V)(see notes 1 and 2) | - | 450 | - | mA |
| Frequency (see note 3) | 8.0 | 9.5 | 12 | GHz |
| P _{out} (see note 2) | 100 | 150 | - | mW |

OPERATING NOTES

1. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always negative. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients.
2. Each device is measured for maximum output power at 9.5GHz in a coaxial test cavity. The bias is optimized for this maximum within the V max. and P_{tot} max. ratings. The operating voltage and corresponding current are quoted for this condition on a test record supplied with each device.
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive single loaded epoxy, such as Epotek H40, may be used.
5. The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

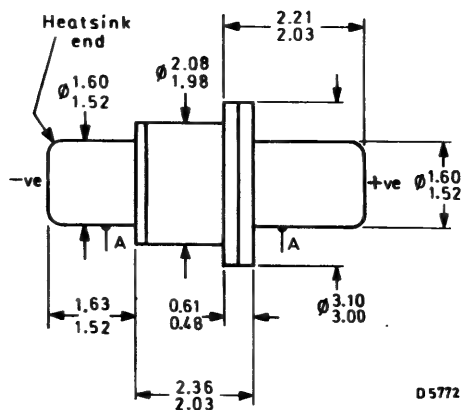
Devices may be selected to suit customers' specific requirements

CXY19A

QUICK REFERENCE DATA

| | | |
|--|---------|-----|
| Operating voltage (note 2) | 8 to 15 | V |
| P _{tot} max. (T _{mb} = 70°C) | 6.0 | W |
| Operating frequency | 8 to 12 | GHz |
| P _{out} min. (f = 9.5GHz) | 200 | mW |

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = +0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--|-------------|----|
| V max. (see note 1) | 15 | V |
| P _{tot} max. (T _{mb} = 70°C) | 6.0 | W |
| Temperature | | |
| T _{mb} range | -40 to +70 | °C |
| T _{stg} range | -55 to +150 | °C |

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

| | Min. | Typ. | Max. | |
|--|------|------|------|-----|
| I _{dc} (at V = 12V) (see notes 1 and 2) | - | 450 | - | mA |
| Frequency (see note 3) | 8.0 | 9.5 | 12 | GHz |
| P _{out} (see note 2) | 200 | 250 | - | mW |

OPERATING NOTES

1. Bias must be applied in such a way that the mounting base (heatsink end) of the device is always negative. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients.
2. Each device is measured for maximum output power at 9.5GHz in a coaxial test cavity. The bias is optimized for this maximum within the V max. and P_{tot} max. ratings. The operating voltage and corresponding current are quoted for this condition on a test record supplied with each device.
3. The frequency is governed by the choice of cavity to which the device is coupled.
4. The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive single loaded epoxy, such as Epotek H40, may be used.
5. The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

Devices may be selected to suit customers' specific requirements

GUNN EFFECT DEVICE

CXY19B

Gallium arsenide bulk effect n^+ sandwich device employing the Gunn effect to produce \leftarrow c.w. oscillations at microwave frequencies. Each device is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

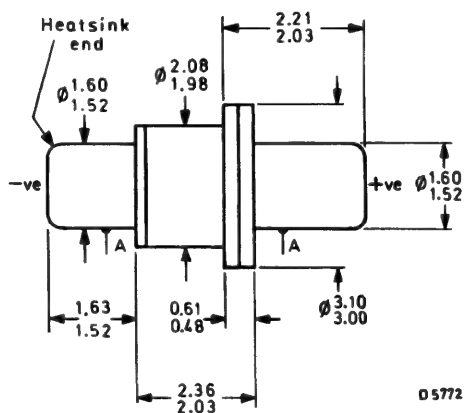
QUICK REFERENCE DATA

| | | |
|--|---------|-----|
| Operating voltage ²⁾ | 8 to 15 | V |
| P_{tot} max. ($T_{\text{mb}} = 70^\circ\text{C}$) | 7.5 | W |
| Operating frequency | 8 to 12 | GHz |
| P_{out} min. ($f = 9.5$ GHz) | 300 | mW |

OUTLINE AND DIMENSIONS

Dimensions in mm

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|-----|---|
| V max. 1) 2) | 15 | V |
| P _{tot} max. (T _{mb} = 70 °C) | 7.5 | W |

Temperature

| | | |
|------------------------|-------------|----|
| T _{mb} range | -40 to +70 | °C |
| T _{stg} range | -55 to +150 | °C |

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

| | Min. | Typ. | Max. | |
|-----------------------|------|------|------|-----|
| I _{dc} 1) 2) | - | 650 | 900 | mA |
| Frequency 3) | 8.0 | 9.5 | 12 | GHz |
| P _{out} 2) | 300 | 325 | - | mW |

Devices may be selected to suit customers' specific requirements

- 1) Bias must be applied in such a way that the mounting base (heatsink end) of the device is always negative. Reversing the polarity may cause permanent damage. Care should be taken to protect the device from transients.
- 2) Each device is measured for maximum output power at 9.5 GHz in a coaxial test cavity. The bias is optimized for this maximum within the V max. and P_{tot} max. ratings. The operating voltage and corresponding current are quoted for this condition on a test record supplied with each device.
- 3) The frequency is governed by the choice of cavity to which the device is coupled.
- 4) The heatsink end of the device should be held in a collet or equivalent clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive single loaded epoxy, such as Epotek H40, may be used.
- 5) The power supply should be low impedance voltage regulated and capable of supplying approximately 1.5 times the normal current, to initiate oscillation.

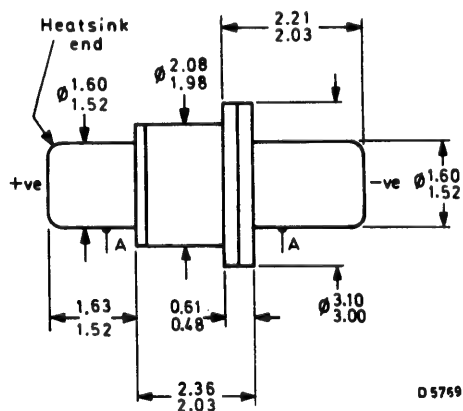
Gallium arsenide bulk effect device employing the Gunn effect to produce c.w. oscillations at microwave frequencies. It is encapsulated in a standard microwave package and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

| | | |
|--|-----------|-----|
| Operating voltage | 8.0 | V |
| $P_{\text{tot max.}}$ ($T_{\text{mb}} = 70^{\circ}\text{C}$) | 2.5 | W |
| Operating frequency range | 8.0 to 12 | GHz |
| $P_{\text{out typ.}}$ (at $f_0 = 9.5$ GHz) | 50 | mW |

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|-------------|----|
| V max. 1) | 10 | V |
| V max. (for less than 1 ms.) | 12 | V |
| P _{tot} max. (T _{mb} = 70 °C) | 2.5 | W |
| T _{mb} range | -40 to +70 | °C |
| T _{stg} range | -55 to +150 | °C |

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

| | Min. | Typ. | Max. | |
|--|------|------|------|-----|
| Frequency range 2) | 8.0 | - | 12 | GHz |
| D. C. operating current (at V = 9.5 V) | - | 210 | 265 | mA |
| → Power output 3) | 40 | 50 | - | mW |

OPERATING NOTES

- 1) The heatsink end is positive. Bias must be applied in such a way that the mounting base end of the device is always positive. Reversal of the bias will cause permanent damage. Care should be taken to prevent the device from transients. An 11 V voltage regulator diode to shunt the power supply is recommended for this purpose.
- 2) The frequency is governed by the choice of cavity to which the device is coupled.
- 3) The power output is normally measured in a coaxial cavity at approximately mid-band frequency. The bias may be optimized to give maximum power output within the limits of V max. and P_{tot} max.
- 4) The heatsink end of the device should be held in a collet or similar clamping system to ensure minimum thermal resistance in the path to the mounting base. This in turn must be coupled to an adequate heatsink. Alternatively, direct soldering, using a low melting point solder, or an electrically conductive single loaded epoxy such as Epotek H40, may be used.
- 5) The power supply should be low impedance voltage regulated and be capable of supplying 1.5 times the normal current, to initiate oscillation.

Devices may be selected to suit customers' specific requirements.

GUNN EFFECT DEVICES

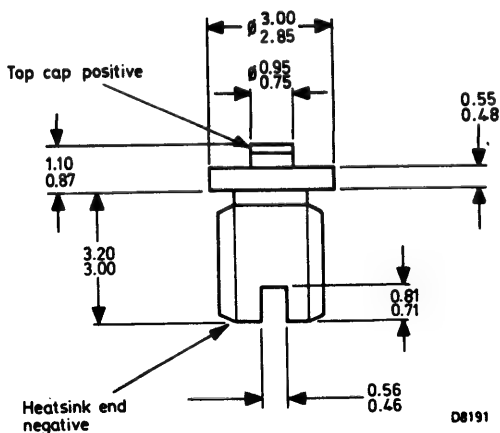
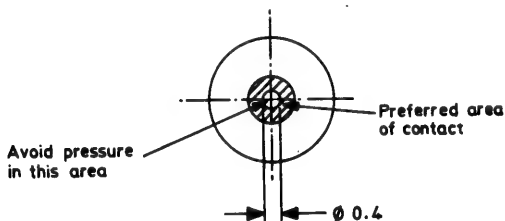
Gallium arsenide bulk effect devices employing the Gunn effect to produce c.w. oscillations at microwave frequencies. They are encapsulated in metal-ceramic packages suitable for mounting in various types of cavity. The devices will oscillate in Q-band (Ka-band), the actual frequency being determined by the type of cavity.

QUICK REFERENCE DATA

| | | | |
|---------------------------|------|----------|-----|
| Operating frequency range | | 30 to 38 | GHz |
| Operating voltage | typ. | 3.5 | V |
| Operating current | typ. | 0.8 | A |
| Power output at 34 GHz | min. | 25 | mW |
| | min. | 50 | mW |

MECHANICAL DATA

Dimensions in mm



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

| | | | |
|---------------------------------------|------|-------------|----|
| Transient supply voltage (note 1) | max. | 6.0 | V |
| Continuous supply voltage | max. | note 2 | |
| Power input (note 2) | max. | 4.0 | W |
| Storage temperature range | | -55 to +150 | °C |
| Operational stud temperature (note 3) | max. | +70 | °C |

CHARACTERISTICS

T_{amb} = 25 °C

| | min. | typ. | max. | |
|-------------------------------|--------|------|------|-----|
| Frequency (notes 4,5) | 30 | 34 | 38 | GHz |
| Operating voltage (notes 1,2) | — | 3.5 | 5.0 | V |
| Operating current (note 6) | — | 0.8 | 1.1 | A |
| Threshold current | — | — | 1.6 | A |
| Power output (note 4) | CXY24A | 25 | 30 | — |
| | CXY24B | 50 | 60 | — |
| | | | | mW |
| | | | | mW |

OPERATING NOTES

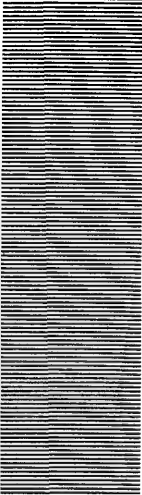
1. Bias must be applied in such a way that the heatsink end of the device is always negative. Reversing the polarity may cause permanent damage. Care should be taken to protect the device against transient voltages.
2. Each device is supplied with a maximum supply voltage recommendation for continuous operation, within the limits of operating voltage and power input specified above.
3. Good thermal conductivity is essential between the heatsink end of the device and the cavity.
4. Power output is normally measured in a waveguide cavity at a frequency of 34 GHz, at a voltage not exceeding the maximum recommended supply voltage (see note 2).
5. The frequency is governed by the choice of cavity to which the device is coupled.
6. The power supply should be low impedance, voltage regulated and capable of supplying current in excess of the threshold current.

Devices may be selected to suit
customers' specific requirements

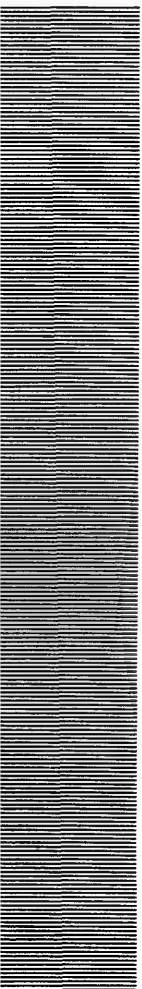


MIXER AND DETECTOR DIODES

C



C



MICROWAVE MIXER/DETECTOR DIODE

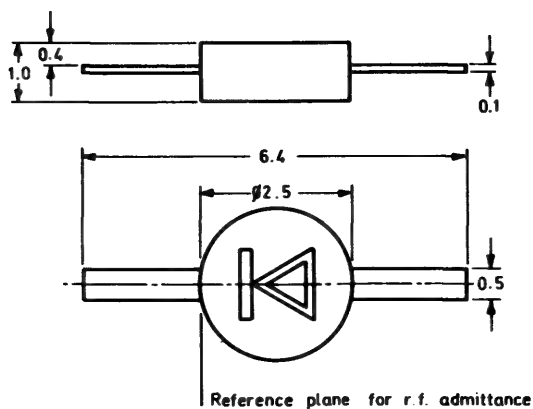
BAT10

Silicon Schottky barrier diode for use as a low level detector or as a low noise mixer at microwave frequencies. The diode is plastic encapsulated with ribbon leads suitable for mounting in stripline circuitry and conforms to the environmental requirements of BS9300 where applicable. Available as a matched pair 2/BAT10 M.

QUICK REFERENCE DATA

| | | |
|--|-----------|------------------|
| Frequency range | 1.0 to 12 | GHz |
| Mixer : | | |
| Typical noise figure in X-band | 7.0 | dB |
| Detector : | | |
| Typical tangential sensitivity in X-band with 100 μ A bias | -50 | dBm |
| Typical current sensitivity in X-band with 50 μ A bias | 5.0 | μ A/ μ W |

OUTLINE AND DIMENSIONS



All dimensions in mm

D3108

Mullard

LIMITING VALUES (Absolute max. rating system)

Electrical

| | | |
|--|-----|-----|
| Maximum peak pulsed r.f. input power at 9.375 GHz, 0.5 μ s pulse length | 1.0 | W |
| Maximum burn out (multiple r.f. spike, $\Delta N_0 = 1$ dB) | 20 | nJ |
| | 0.2 | erg |

Temperature

| | | |
|------------------------|-------------|----|
| T _{stg} range | -55 to +150 | °C |
| T _{amb} range | -55 to +150 | °C |

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

| | | Typ. | Max. | |
|-----------------|--|------|------|------------------|
| Mixer | | | | |
| N ₀ | Noise figure ¹⁾ | 7.0 | 7.5 | dB |
| v.s.w.r. | Voltage standing wave ratio ²⁾ | - | 2:1 | |
| Z _{if} | Intermediate frequency impedance ³⁾ | - | 500 | Ω |
| Detector | | | | |
| S _{ts} | Tangential sensitivity ⁴⁾ | -50 | - | dBm |
| S _i | Current sensitivity ⁵⁾ | 5.0 | - | μ A/ μ W |
| v.s.w.r. | Voltage standing wave ratio ⁶⁾ | - | 5:1 | |
| Z _v | Video impedance ⁷⁾ | 600 | - | Ω |
| $\frac{1}{f}$ | Noise | 12 | 17 | dB |

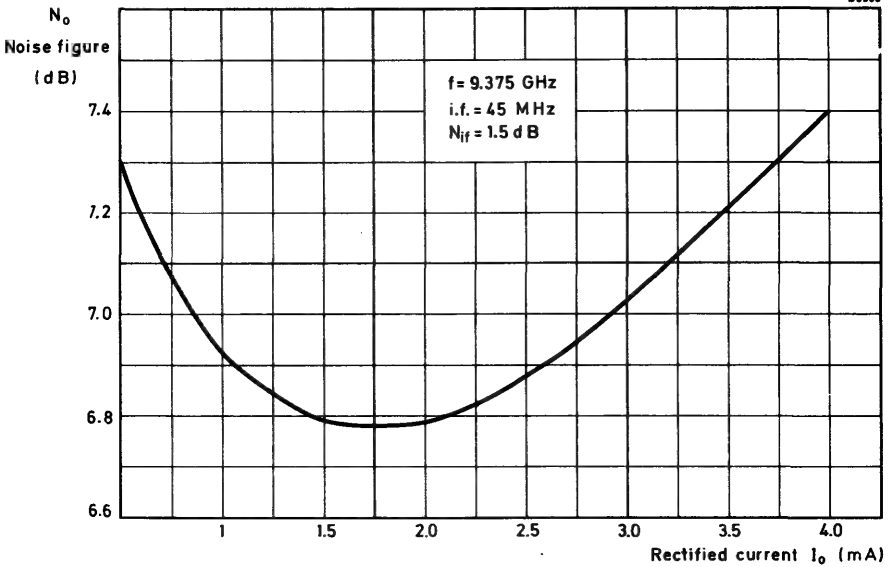
NOTES

1. Measured in a 50 Ω test mount at f = 9.375 GHz, rectified current = 2.0 mA, load resistance = 20 Ω , i.f. = 45 MHz and i.f. noise figure = 1.5 dB. BS9300.
2. Measured with respect to 50 Ω at f = 9.375 GHz, rectified current = 2.0 mA, and load resistance = 10 Ω . BS9300.
3. Measured in a 50 Ω test mount at f = 9.375 GHz, rectified current = 2.0 mA, load resistance = 20 Ω and i.f. = 45 MHz. BS9300.
4. Measured at f = 9.375 GHz with 2.0 MHz bandwidth and 100 μ A bias.
5. Measured at f = 9.375 GHz at an input power of 1.0 μ W and 50 μ A bias.
6. Measured with respect to 50 Ω at f = 9.375 GHz, 100 μ A bias and c.w. input less than 2.0 μ W. BS9300.
7. D.C. measurement with 1.0 mV max. and 50 μ A bias.

MICROWAVE MIXER/DETECTOR DIODE

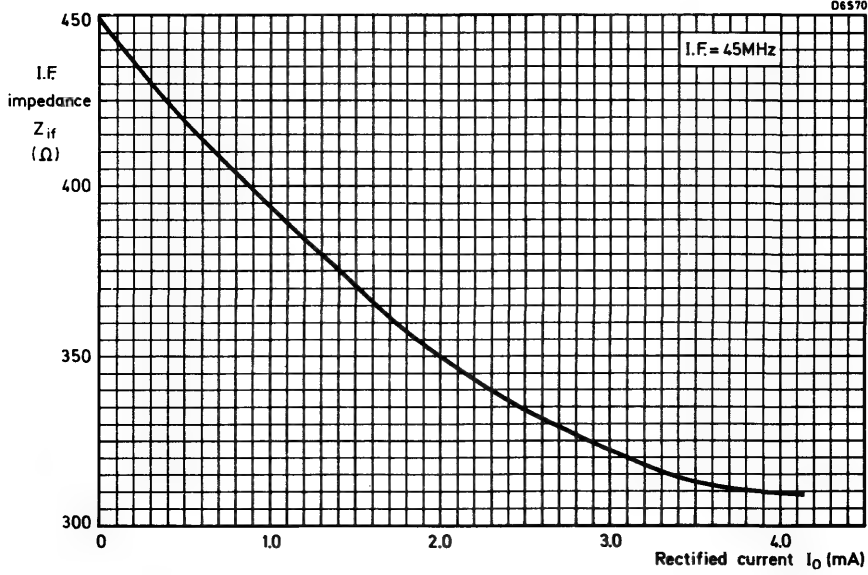
BAT10

06569

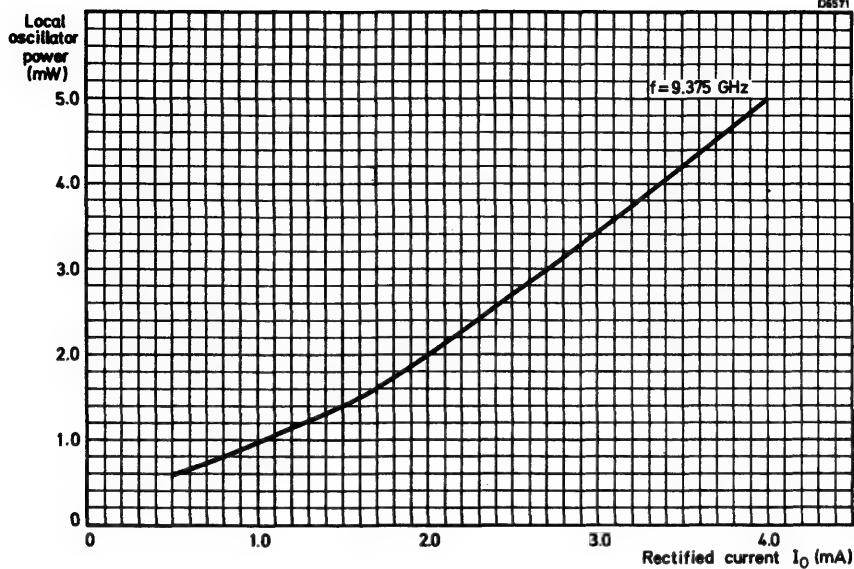


TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT
(MIXER APPLICATION)

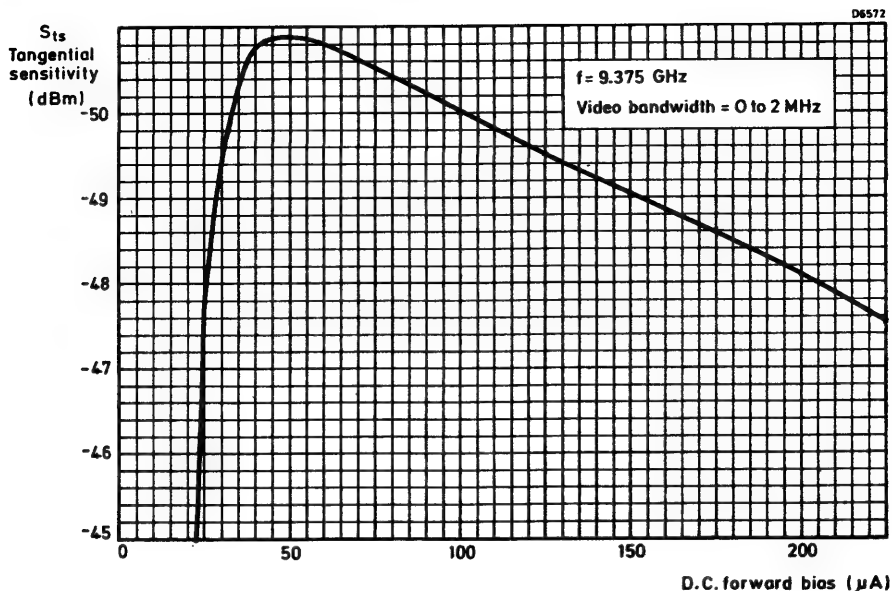
06570



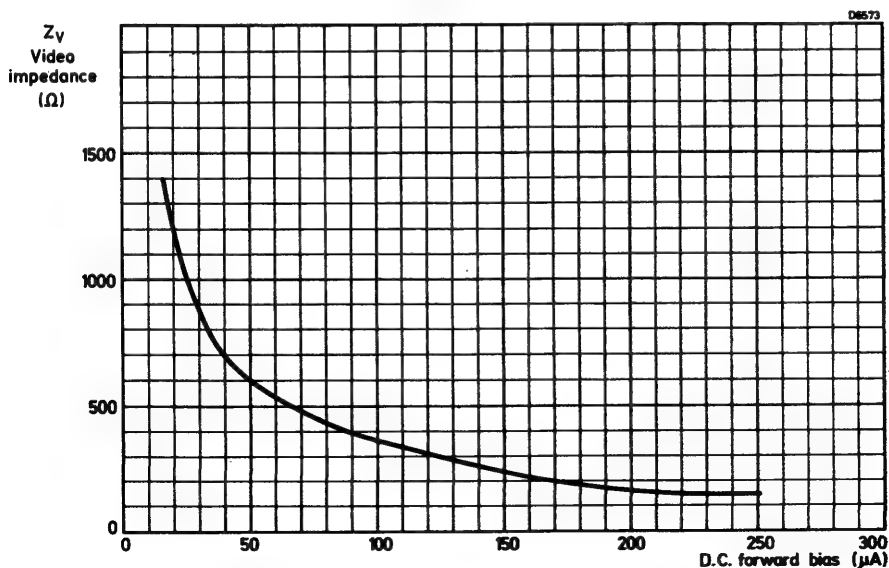
TYPICAL I. F. IMPEDANCE AS A FUNCTION OF RECTIFIED CURRENT
(MIXER APPLICATION)



TYPICAL LOCAL OSCILLATOR POWER AS A FUNCTION OF RECTIFIED CURRENT
(MIXER APPLICATION)



TYPICAL TANGENTIAL SENSITIVITY AS A FUNCTION OF
D.C. FORWARD BIAS CURRENT (DETECTOR APPLICATION)



TYPICAL VIDEO IMPEDANCE AS A FUNCTION OF
D.C. FORWARD BIAS CURRENT. (DETECTOR APPLICATION)



7

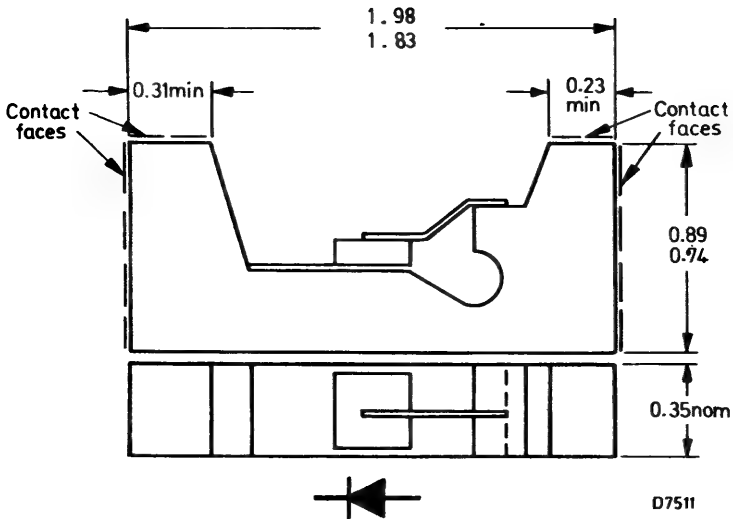
Silicon Schottky barrier low noise mixer diode mounted in a L.I.D. type envelope. ←
Primarily intended for hybrid integrated circuit applications in X-band. It conforms to the environmental requirements of BS9300 where applicable. Available as a matched pair 2/BAT11 M.

QUICK REFERENCE DATA

| | | |
|--------------------------------|----------|-----|
| Typical noise figure in X-band | 6.5 | dB |
| Frequency range | up to 12 | GHz |

MECHANICAL DATA

Dimensions in mm



Contact faces are gold plated, .5 μ m over 1.27 μ m of nickel.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|-------------------------------------|-----|-----|
| Max. burn-out (r.f. spike) | 20 | nJ |
| | 0.2 | erg |
| Max. burn-out (multiple d.c. spike) | 30 | nJ |
| | 0.3 | erg |

Temperature

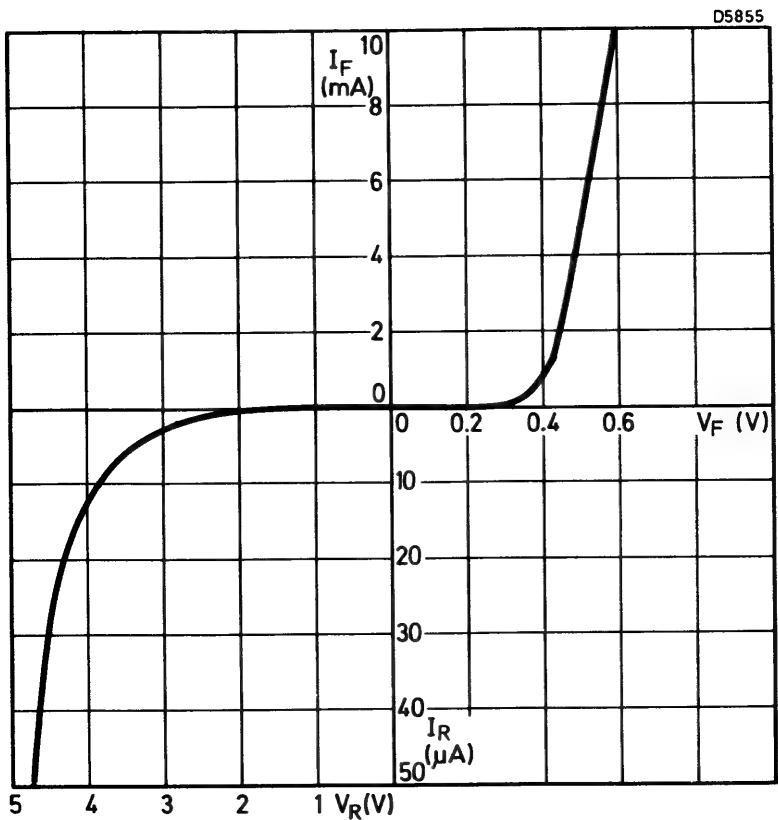
| | | |
|-----------------|-------------|--------------------|
| T_{stg} range | -55 to +150 | $^{\circ}\text{C}$ |
| T_{amb} | -55 to +150 | $^{\circ}\text{C}$ |

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$)

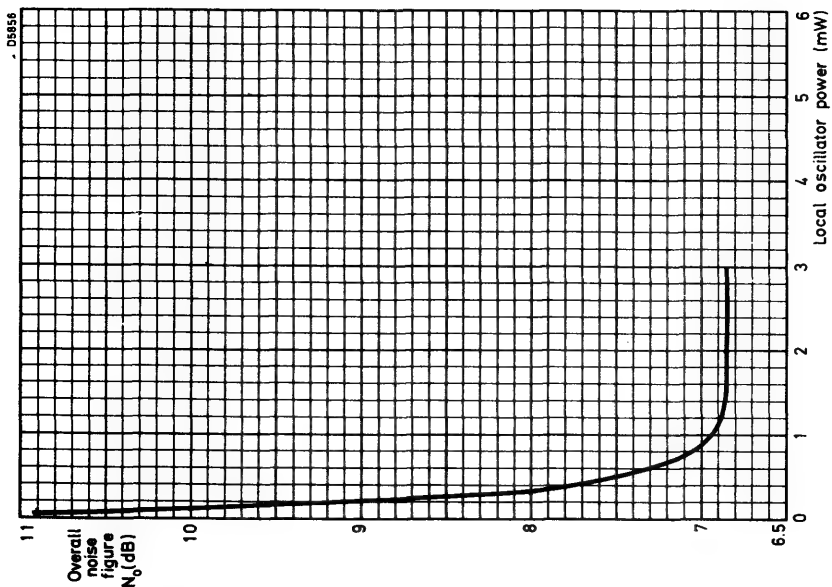
| | | Min. | Typ. | Max. | |
|----------|--|------|--------------------------|--------------------------|----------|
| Dynamic | | | | | |
| N_o | Noise figure (see note 1) | - | 6.5 | 7.0 | dB |
| Z_{rf} | R. F. impedance spread referred to 50 Ω bounded by co-ordinates (see note 2). | | 0.6 - j0.3 0.6 + j0.3 | 0.4 - j0.3 0.4 + j0.3 | |
| Z_{if} | Intermediate frequency impedance (see note 3) | 280 | 320 | 380 | Ω |
| f | Operating frequency range | - | - | 12 | GHz |

NOTES

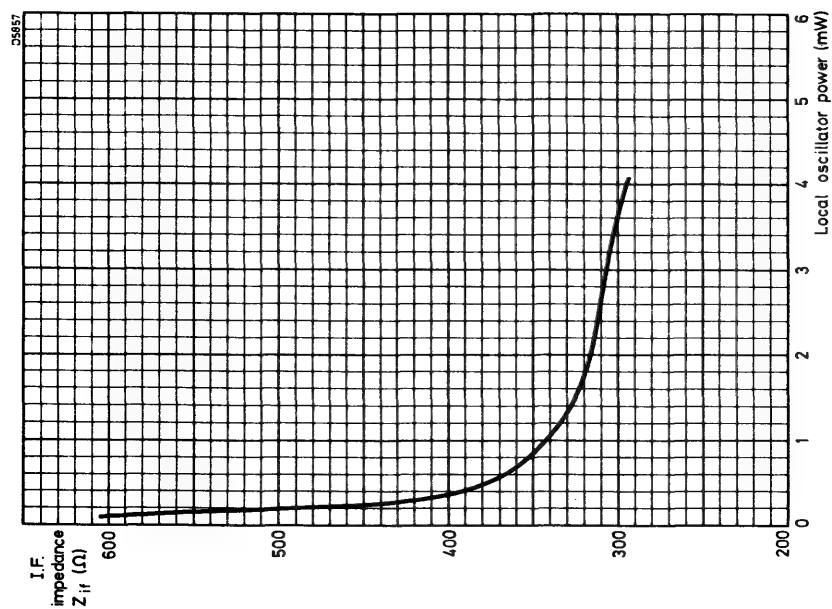
1. Measured at 9.375GHz \pm 0.1GHz, 1.5mA rectified current, $R_L = 15\Omega$. N_o includes $N_{if} = 1.5\text{dB}$ with 45MHz intermediate frequency. BS9321/1406.
2. Measured at 9.375GHz \pm 0.1GHz, 1.5mA rectified current, $R_L = 15\Omega$. BS9321/1409.
3. Measured at 9.375GHz \pm 0.1GHz, 1.5mA rectified current, $R_L = 15\Omega$, intermediate frequency 45MHz, BS9321/1405.
4. Maximum out of balance condition for a matched pair:
 - a) 0.1mA rectified current.
 - b) R. F. admittance 1.15:1 with other diode normalized to 50 Ω .
5. The diode may be mounted on microstrip, using conventional thermocompression or micro-gap bonding techniques. Alternatively, the application of a singleloaded epoxy, such as Epotek H40, may be used, followed by polymerisation at 150 $^{\circ}\text{C}$ for 15 minutes. The force applied to the L.I.D. must not exceed 147mN (15gf).
6. Devices may be specially selected with the r.f. impedance measured at a customer's specific frequency in the range 8.4 to 12GHz.



TYPICAL D. C. CHARACTERISTIC



TYPICAL OVERALL NOISE FIGURE AS
A FUNCTION OF LOCAL OSCILLATOR POWER



TYPICAL I.F. IMPEDANCE AS A FUNCTION
OF LOCAL OSCILLATOR POWER

MICROWAVE MIXER DIODE

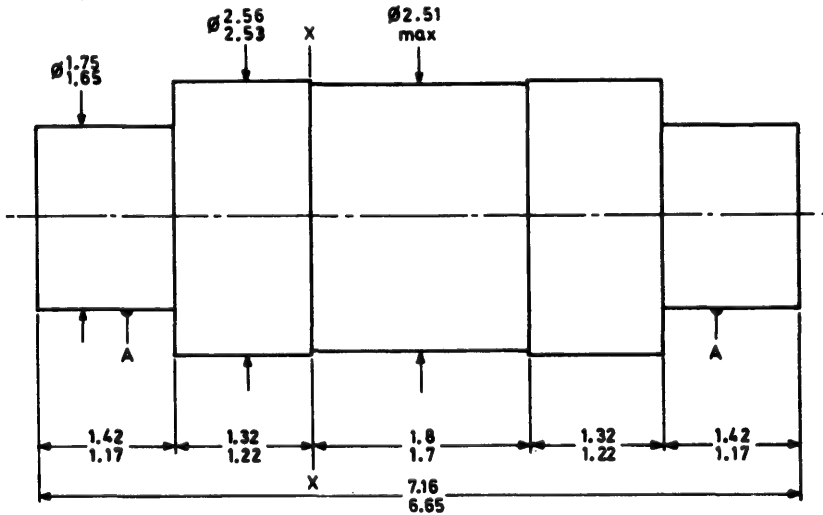
Subminiature silicon Schottky barrier mixer diode for use at Q-band (Ka-band) frequencies. Where applicable, this device conforms to the environmental requirements of BS9300.

QUICK REFERENCE DATA

| | | | |
|-----------------|------|----------|-----|
| Frequency range | | 26 to 40 | GHz |
| Noise figure | typ. | 8.5 | dB |

MECHANICAL DATA

Dimensions in mm



02527a

Fig.1

The cathode (positive) is marked red.

The cathode indicates the electrode which becomes positive in an a.c. rectifier circuit.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Burn-out

| | | | |
|--|------|------|-----|
| R.F. spike | max. | 0.04 | erg |
| Peak pulse power ($t_p = 0.2 \mu s$) | max. | 0.5 | W |

The devices are 100% burn-out screened to the above specifications at 34 GHz.

Temperature

| | | | |
|---------------------|-----------|-------------|----|
| Storage temperature | T_{stg} | -55 to +100 | °C |
| Ambient temperature | T_{amb} | -55 to +100 | °C |

CHARACTERISTICS $T_{amb} = 25^\circ C$

| | | | | |
|--|----------|-----------|--------------------|----------------------|
| Reverse current $V_R = 0.5 V$ | I_R | typ. | 2.0 | μA |
| Forward current $V_F = 0.5 V$ | I_F | typ. | 2.0 | mA |
| Overall noise figure f = 34.86 GHz, rectified current = 0.5 mA N_O includes N_{if} of 1.5 dB (BS9321/1406) | N_O | typ. < | 8.5 10 | dB |
| Conversion loss | L_c | typ. | 5.5 | dB |
| Noise temperature ratio I.F. = 45 MHz | N_r | | 1.6:1 | |
| Voltage standing wave ratio* f = 34.86 GHz, rectified current = 0.5 mA $R_L = 15 \Omega$ (BS9321/1409) | v.s.w.r. | typ. < | 1.4:1 1.8:1 | |
| Intermediate frequency impedance f = 34.86 GHz, rectified current = 0.5 mA $R_L = 15 \Omega$, i.f. = 45 MHz (BS9321/1405) | Z_{if} | typ. | 900 700 to 1100 | Ω Ω |
| Operating frequency range | f | | 26 to 40 | GHz |

MATCHED PAIRS

The diodes can be supplied in matched pairs under the type number 2/BAT38M. The diodes are matched to $\pm 10\%$ on rectified current and within 150Ω i.f. impedance.

* Standard test holder.



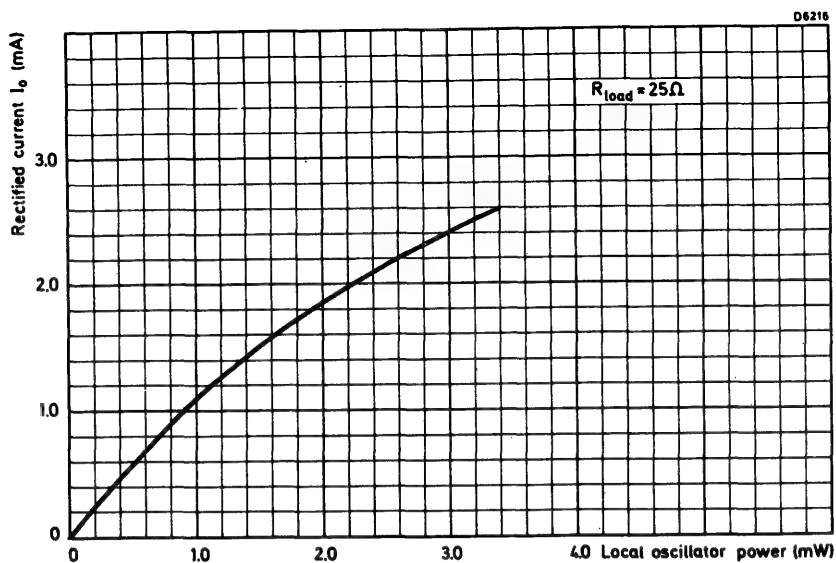


Fig.2 Typical rectified current as a function of local oscillator power at 34.86 GHz

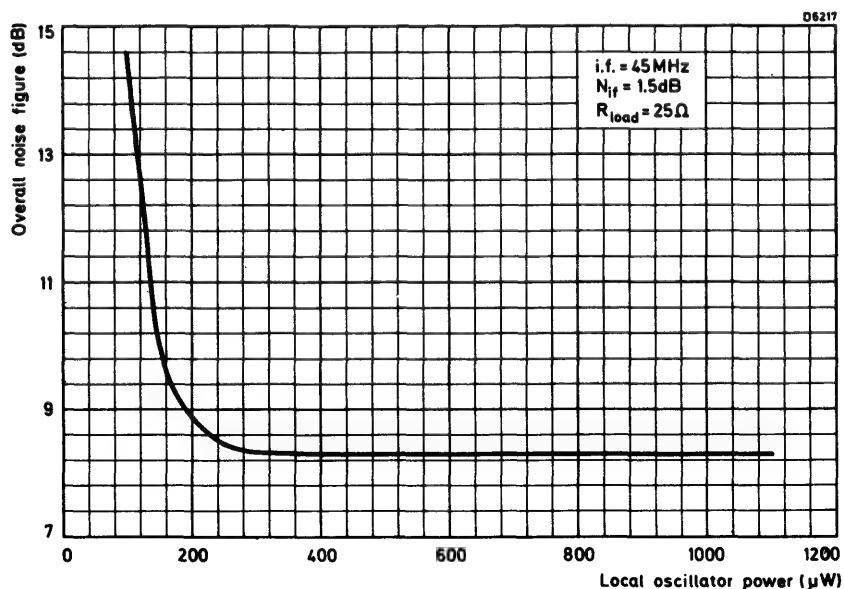


Fig.3 Typical overall noise figure as a function of local oscillator power at 34.86 GHz



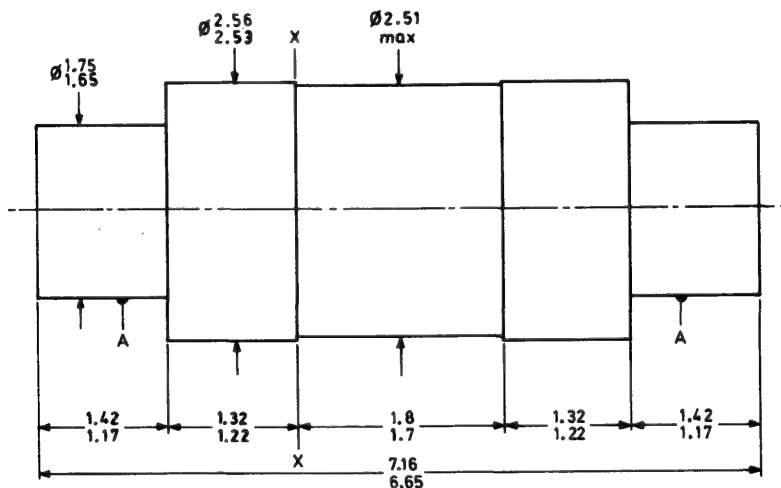
BAT39
BAT39A

QUICK REFERENCE DATA

| | | | | |
|------------------------|--------|------|-----------|-----|
| Operating frequency | | | 1.0 to 18 | GHz |
| Noise figure at X-band | BAT39 | typ. | 6.0 | dB |
| | BAT39A | typ. | 7.0 | dB |

MECHANICAL DATA

Dimensions in mm



All dimensions in mm

02527 a

AA = concentricity tolerance = ± 0.15

The positive end indicates the electrode which becomes positive in an a.c. rectifier circuit.

WG16 holders to fit these diodes are available from Marconi Instruments Ltd., (Sanders Division), Gunnels Wood Road, Stevenage, Herts.

RATINGS In accordance with the Absolute Maximum Ratings System (IEC134)

Burn-out $f = 9.375 \text{ GHz}$

| | | | |
|---------------------|------|-----|-----|
| Multiple d.c. spike | max. | 0.1 | erg |
|---------------------|------|-----|-----|

| | | | |
|--|------|------|-----|
| Multiple r.f. spike (spike width at half peak power = $2 \mu\text{s}$) | max. | 0.05 | erg |
|--|------|------|-----|

Peak pulse power

| | | | |
|---|------|-----|---|
| $f = 9.375 \text{ GHz}$, $t_p = 1.0 \mu\text{s}$ | max. | 0.5 | W |
|---|------|-----|---|

Temperatures

| | | | |
|---------------------|-----------|-------------|--------------------|
| Storage temperature | T_{stg} | -55 to +100 | $^{\circ}\text{C}$ |
|---------------------|-----------|-------------|--------------------|

| | | | |
|---------------------|-----------|-------------|--------------------|
| Ambient temperature | T_{amb} | -55 to +100 | $^{\circ}\text{C}$ |
|---------------------|-----------|-------------|--------------------|

CHARACTERISTICS

$T_{amb} = 25^{\circ}\text{C}$

| | | Min. | Typ. | Max. | |
|--|-------|------|------|------|---------------|
| <u>Reverse current</u> $V_R = 0.5 \text{ V}$ | I_R | - | - | 2.0 | μA |
| <u>Forward current</u> $V_F = 0.5 \text{ V}$ | I_F | - | 7.0 | - | mA |

Overall noise figure

| | | | | | | |
|---|--------|-------|-----|-----|-----|----|
| $f = 9.375 \text{ GHz}$, $R_L = 15 \Omega$, rectified current = 1.0 mA | BAT39 | N_O | 5.5 | 6.0 | 6.5 | dB |
| N_O includes $N_{if} = 1.5 \text{ dB}$ (BS9300/1406 Method B) | BAT39A | N_O | - | 7.0 | 7.5 | dB |

Conversion loss

| | | | | | |
|--------|-------|---|-----|---|----|
| BAT39 | L_C | - | 4.2 | - | dB |
| BAT39A | L_C | - | 5.0 | - | dB |

Noise temperature ratio

| | | | | | |
|---------------------------------------|--------|-------|---|--------|---|
| $I.F. = 45 \text{ MHz}$ (BS9300/1407) | BAT39 | N_T | - | 1.1: 1 | - |
| | BAT39A | N_T | - | 1.2: 1 | - |

Voltage standing wave ratio

| | | | | |
|---|------------|---|---|---------|
| $f = 9.375 \text{ GHz}$, $R_L = 15 \Omega$, rectified current = 1.0 mA (BS300/1409) | $v.s.w.r.$ | - | - | 1.43: 1 |
| Measured in standard test holder | | | | |

Intermediate frequency impedance

| | | | | | |
|--|----------|-----|---|-----|----------|
| $f = 9.375 \text{ GHz}$, $R_L = 15 \Omega$, rectified current = 1.0 mA (BS9300/1405) | Z_{if} | 250 | - | 450 | Ω |
|--|----------|-----|---|-----|----------|

| | | | | | |
|----------------------------------|-----|-----|---|----|-----|
| <u>Operating frequency range</u> | f | 1.0 | - | 18 | GHz |
|----------------------------------|-----|-----|---|----|-----|

OPERATING NOTE

Optimum performance is obtained with BAT39 and BAT39A when the local oscillator drive is adjusted to give a diode rectified current of 1.0 mA and the load resistance is restricted to 100 Ω max.

APPLICATION INFORMATION

Mixer performance at other than Test Radio Frequency

Measured overall noise figure

| | | | | |
|--|-------|------|-----|----|
| $f = 16.5 \text{ GHz}$, $N_{if} = 1.5 \text{ dB}$, i.f. = 45 MHz | N_o | typ. | 7.0 | dB |
| $f = 3.0 \text{ GHz}$, $N_{if} = 1.5 \text{ dB}$, i.f. = 45 MHz | N_o | typ. | 5.5 | dB |
| $f = 9.5 \text{ GHz}$, i.f. = 3.0 kHz | N_o | typ. | 29 | dB |

Signal/flicker noise at 9.5 GHz

Measured at 2.0 kHz from carrier in
a 70 Hz bandwidth

typ. 131 dB

Detector performance

Tangential sensitivity at 9.375 GHz,

1 kHz to 1 MHz video bandwidth,

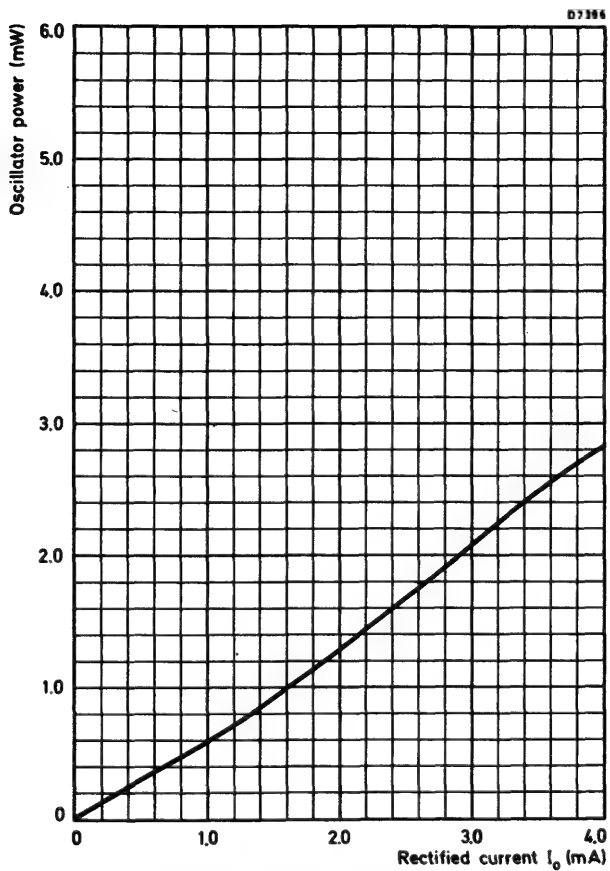
I_F (bias) = 50 μA (BS9300/1411)

S_{ts} typ. -52 dbm

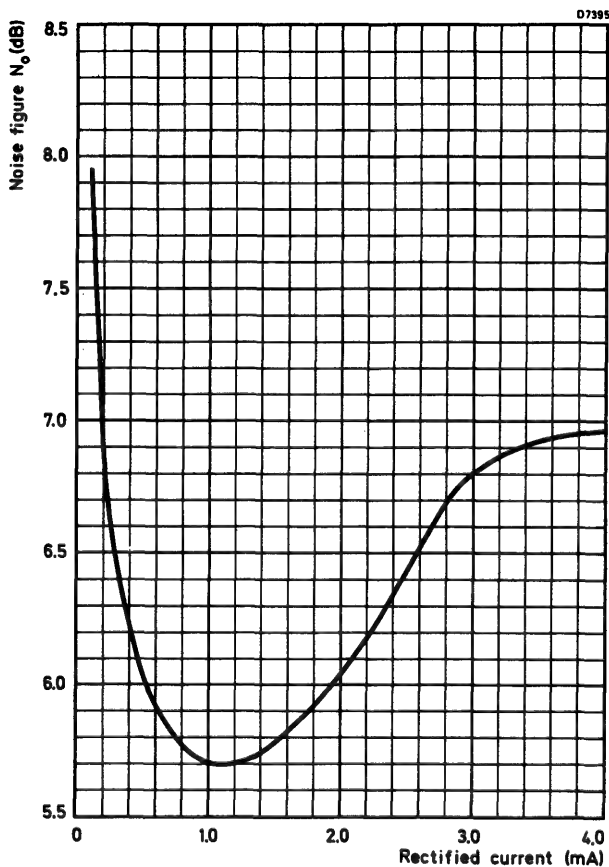
A.C. video impedance

I_F (bias) = 50 μA (BS9300/1403)

Z_T typ. 800 Ω



Typical rectified current as a
function of local oscillator power



Typical noise figure as a function
of rectified current

Coaxial silicon Schottky barrier diodes for use in pre-tuned X-band low noise mixer ← circuits. They are intended for use as low noise retrofits at X-band frequencies for coaxial mixer diodes types AAY50, AAY50R etc. The two types have identical dimensions and characteristics but the polarity is reversed. The pair are intended for use in balanced mixer circuits and conform to the environmental requirements of BS9300 where applicable.

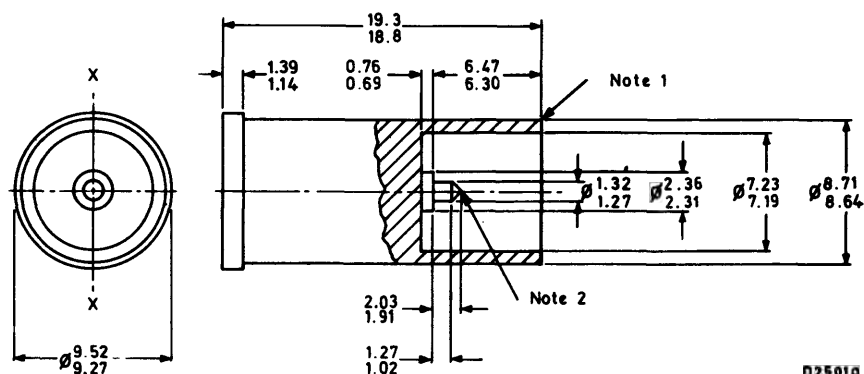
QUICK REFERENCE DATA

| | | | |
|---------------------|------|-----|-----|
| Operating frequency | max. | 12 | GHz |
| Noise figure | typ. | 6.2 | dB |

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-26



D25010

Terminal identification

| | | | | | |
|-------|-----------------|---------|--------|-------------------|---------|
| BAT50 | Pin | cathode | BAT50R | Pin | anode |
| | Body (red spot) | anode | | Body (green spot) | cathode |

ACCESSORIES

Holders to fit these coaxial diodes are available in the U.K. from Marconi Instruments (Sanders Division) Gunnels Wood Rd., Stevenage, Herts.

Note 1. The device is designed to make contact on this open face.

Note 2. Cone tapers to a radius of 0.13 mm nominal.

RATINGS In accordance with the Absolute Maximum Rating System (IEC134)Burn-out

| | | | |
|-------------|------|-----|-----|
| R. F. spike | max. | 0.2 | erg |
|-------------|------|-----|-----|

Peak pulse power

| | | | |
|-------------------|------|-----|---|
| $t_p = 0.5 \mu s$ | max. | 1.0 | W |
|-------------------|------|-----|---|

Temperatures

| | | | |
|---------------------|-----------|-------------|-------------|
| Storage temperature | T_{stg} | -55 to +100 | $^{\circ}C$ |
|---------------------|-----------|-------------|-------------|

| | | | |
|---------------------|-----------|-------------|-------------|
| Ambient temperature | T_{amb} | -55 to +100 | $^{\circ}C$ |
|---------------------|-----------|-------------|-------------|

CHARACTERISTICS $T_{amb} = 25^{\circ}C$

| | | | | |
|------------------------|---------------|-------|-----|---------|
| <u>Reverse current</u> | $V_R = 0.5 V$ | I_R | 3.0 | μA |
|------------------------|---------------|-------|-----|---------|

| | | | | |
|------------------------|---------------|-------|-----|----|
| <u>Forward current</u> | $V_F = 0.5 V$ | I_F | 7.0 | mA |
|------------------------|---------------|-------|-----|----|

Overall noise figure 1)

| | | | | |
|--|-------|------|-----|----|
| $f = 9.375 \text{ GHz}$, rectified current = 1.0 mA, | N_o | typ. | 6.2 | dB |
| $R_L = 15 \Omega$, N_o includes $N_{if} = 1.5 \text{ dB}$ | | max. | 6.8 | dB |

Conversion loss

| | | |
|-------|-----|----|
| L_c | 4.4 | dB |
|-------|-----|----|

Noise temperature ratio

| | | |
|----------------|-------|-------|
| I. F. = 45 MHz | N_T | 1.1:1 |
|----------------|-------|-------|

Voltage standing wave ratio 1) 2)

| | | | |
|--|---------------|------|--------|
| $f = 9375 \pm 10\% \text{ MHz}$, rectified current 1.0 mA | $v. s. w. r.$ | max. | 1.43:1 |
| $R_L = 15 \Omega$, N_o includes $N_{if} = 1.5 \text{ dB}$ | | | |

Intermediate frequency impedance

| | | | |
|----------|------|-----|----------|
| Z_{if} | min. | 300 | Ω |
| | max. | 500 | Ω |

Operating frequency range

| | | | |
|-----|------|----|-----|
| f | max. | 12 | GHz |
|-----|------|----|-----|

1) Measured in standard holder (K1007, Issue 3, Section 8B3.3.1/2.)

2) The nominal rectifier admittance at a plane 7.01 mm inside the body from the open end is

$$\frac{1}{83.5} + \frac{j}{350} \text{ mho.}$$

OPERATING NOTE

These devices will exhibit their inherent improved noise figure performance over the frequency range 1.0 to 12 GHz, but are not recommended for use as direct replacements in pre-tuned mounts designed for the AAY50 type coaxial diode, at other than X-band frequencies.

APPLICATION INFORMATION

Signal/Flicker noise ratio

| | | | | |
|--|--|------|-----|----|
| $f = 9.5 \text{ GHz. Measured at } 2 \text{ kHz from carrier}$ | | | | |
| $\text{in } 70 \text{ Hz bandwidth}$ | | typ. | 131 | dB |

Detector performance

| | | | | |
|---|-------|------|-----|----------|
| Tangential sensitivity, $f = 9.375 \text{ GHz,}$ | | | | |
| video bandwidth = $1.0 \text{ MHz, } I_F \text{ (bias)} = 50 \mu\text{A}$ | S_t | typ. | -52 | dBm |
| video impedance, $I_F \text{ (bias)} = 50 \mu\text{A}$ | Z_v | typ. | 800 | Ω |

BAT51
BAT51R

QUICK REFERENCE DATA

| | | | |
|-----------------|------|----------|-----|
| Frequency range | | 12 to 18 | GHz |
| Noise figure | typ. | 7.0 | dB |

MECHANICAL DATA

Dimensions in mm ←

***These limits apply only over 10.32 dimension**

BAT51 Pin cathode
Body (red) anode

BAT51R Pin anode
Body (green) cathode

RATINGS In accordance with the Absolute Maximum System (IEC134)**Burn-out**

$f = 9.375 \text{ GHz}$, multiple r. f. spike,
 spike width at half peak power = 2 ns

max. 0.05 erg

Peak pulse power

$f = 9.375 \text{ GHz}$, $t_p = 1.0 \mu\text{s}$

max. 0.5 W

Temperatures

Storage temperature

T_{stg} -55 to +100 °C

Ambient temperature

T_{amb} -55 to +100 °C

CHARACTERISTICS

$T_{\text{amb}} = 25 \text{ °C}$

Reverse current $V_R = 0.5 \text{ V}$

I_R max. 0.2 μA

Forward current $V_F = 0.5 \text{ V}$

I_F typ. 7.0 mA

Overall noise figure

$f = 13.5 \text{ GHz}$,

N_o includes $N_{\text{if}} = 1.5 \text{ dB}$

Measured in JAN 201 holder (BS9300/1406 Method A)

N_o typ. 7.0 dB
 max. 7.5 dB

Conversion loss

L_C 5.2 dB

Noise temperature ratio

I. F. = 45 MHz (BS9300/1407)

N_T 1.1:1

Voltage standing wave ratio

$f = 13.5 \text{ GHz}$

1.5:1

Intermediate frequency impedance

Z_{if} min. 250 Ω
 typ. 350 Ω
 max. 450 Ω

Operating frequency range

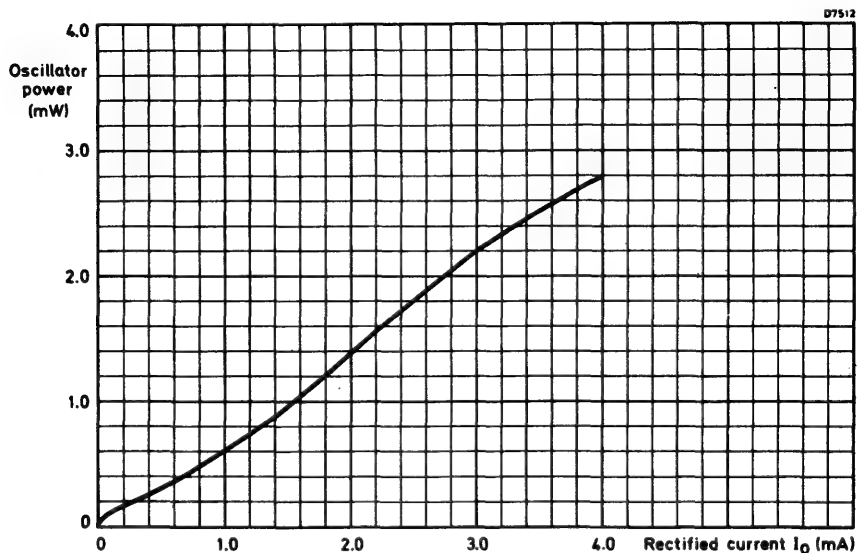
f 12 to 18 GHz

FINISH

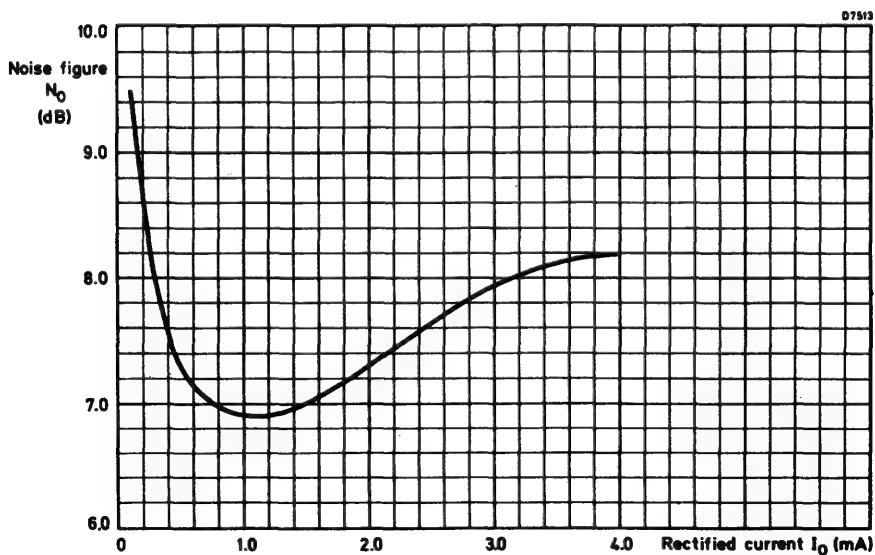
The bodies are cadmium plated in order to be compatible with an aluminium holder

MATCHED PAIR

Maximum unbalance conditions, $Z_{\text{if}} = 25 \Omega$, rectified current 0.1 mA.



Typical rectified current as a function of local oscillator power



Typical noise figure as a function of rectified current

MICROWAVE MIXER DIODES

BAT52
BAT52R

The BAT52 and BAT52R form a reverse pair of mixer diodes for use in balanced mixer circuits at J-band (Ku band). The diodes are of silicon Schottky barrier construction and are intended as retrofits for AAY52 and AAY52R. They are packaged in the standard coaxial outline for this band, similar to IN78 types. The encapsulation is hermetically sealed and the devices conform to the environmental requirements of BS9300 where applicable. Available as a matched pair as 2/BAT52MR.

QUICK REFERENCE DATA

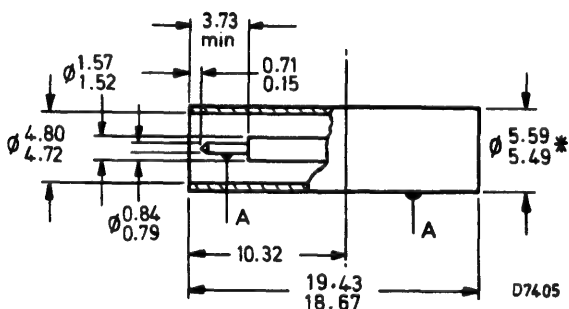
| | | |
|-----------------|----------|-----|
| Frequency range | 12 to 18 | GHz |
| Noise figure | typ. 8.0 | dB |

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA

Dimensions in mm ←

DO-37



A = concentricity tolerance = ± 0.35

*These limits apply only over 10.32 dimension

Terminal identification

BAT52 Pin cathode
Body (red) anode

BAT52R Pin anode
Body (green) cathode

Mullard

RATINGS In accordance with the Absolute Maximum System (IEC134)**Burn-out**

$f = 9.375 \text{ GHz}$, multiple r.f. spike,
 spike width at half peak power = 2 ns

max. 0.05 erg

Peak pulse power

$f = 9.375 \text{ GHz}$, $t_p = 1.0 \mu\text{s}$

max. 0.5 W

Temperatures

Storage temperature

T_{stg} -55 to +100 °C

Ambient temperature

T_{amb} -55 to +100 °C

CHARACTERISTICS

$T_{\text{amb}} = 25 \text{ °C}$

Reverse current $V_R = 0.5 \text{ V}$

I_R max. 0.2 μA

Forward current $V_F = 0.5 \text{ V}$

I_F typ. 7.0 mA

Overall noise figure

$f = 13.5 \text{ GHz}$,

N_o includes $N_{\text{ff}} = 1.5 \text{ dB}$

Measured in JAN 201 holder (BS9300/1406 Method A)

N_o typ. 8.0 dB
 max. 8.5 dB

Conversion loss

L_C 5.2 dB

Noise temperature ratio

I. F. = 45 MHz (BS9300/1407)

N_T 1.1:1

Voltage standing wave ratio

→ $f = 13.5 \text{ GHz}$, rectified current = 0.9 mA

1.5:1

Intermediate frequency impedance

Z_{if} min. 250 Ω
 typ. 350 Ω
 max. 450 Ω

Operating frequency range

f 12 to 18 GHz

FINISH

The bodies are cadmium plated in order to be compatible with an aluminium holder

MATCHED PAIR

Maximum unbalance conditions, $Z_{\text{if}} = 25 \Omega$, rectified current 0.1 mA.

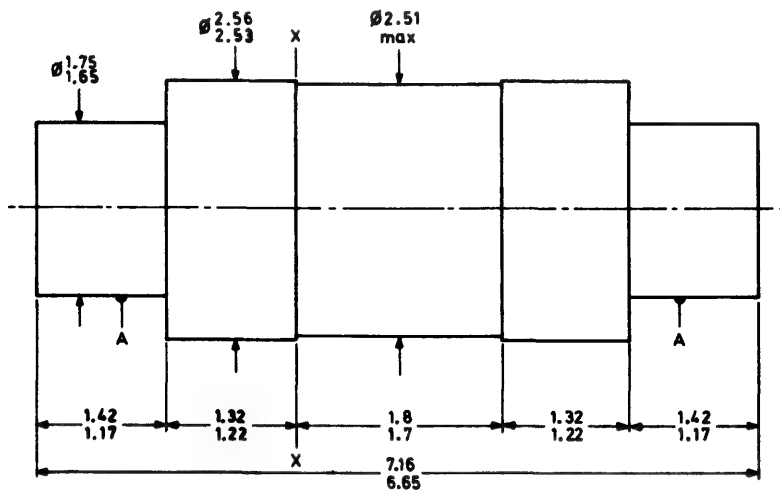
Subminiature silicon Schottky barrier mixer diode for use at Q-band (Ka-band). Where applicable, this device conforms to the environmental requirements of BS9300.

QUICK REFERENCE DATA

| | | |
|-----------------|----------|-----|
| Frequency range | 26 to 40 | GHz |
| Noise figure | typ. 8.5 | dB |

MECHANICAL DATA

Dimensions in mm



XX = reference plane

AA = concentricity tolerance = ± 0.15

02627a

The cathode (positive) is marked red.

The cathode indicates the electrode which becomes positive in an a. c. rectifier circuit.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

→ Burn-out (at 9.375 GHz)

| | | | | |
|------------|--|------|------|-----|
| R.F. spike | | max. | 0.04 | erg |
|------------|--|------|------|-----|

| | | | | |
|---|--|------|-----|---|
| <u>Peak pulse power</u> ($t_p = 0.2 \mu s$) | | max. | 0.5 | W |
|---|--|------|-----|---|

Temperature

| | | | | |
|---------------------|-----------|--|-------------|-------------|
| Storage temperature | T_{stg} | | -55 to +100 | $^{\circ}C$ |
|---------------------|-----------|--|-------------|-------------|

| | | | | |
|---------------------|-----------|--|-------------|-------------|
| Ambient temperature | T_{amb} | | -55 to +100 | $^{\circ}C$ |
|---------------------|-----------|--|-------------|-------------|

CHARACTERISTICS

$T_{amb} = 25^{\circ}C$

| | | | | |
|--------------------------------------|-------|------|-----|---------|
| <u>Reverse current</u> $V_R = 0.5 V$ | I_R | typ. | 2.0 | μA |
|--------------------------------------|-------|------|-----|---------|

| | | | | |
|--------------------------------------|-------|------|-----|----|
| <u>Forward current</u> $V_F = 0.5 V$ | I_F | typ. | 2.0 | mA |
|--------------------------------------|-------|------|-----|----|

Overall noise figure

| | | | | |
|---|-------|------|-----|----|
| $f = 34.86 GHz$, rectified current = 0.5 mA | N_o | typ. | 8.5 | dB |
| N_o includes N_{if} of 1.5 dB (BS9321/1406) | | < | 10 | dB |

| | | | | |
|------------------------|-------|------|-----|----|
| <u>Conversion loss</u> | L_c | typ. | 5.5 | dB |
|------------------------|-------|------|-----|----|

Noise temperature ratio

| | | | | |
|---------------|-------|--|--------|--|
| I.F. = 45 MHz | N_T | | 1.6: 1 | |
|---------------|-------|--|--------|--|

Voltage standing wave ratio ¹⁾

| | | | | |
|--|------------|------|--------|--|
| $f = 34.86 GHz$, rectified current = 0.5 mA | $v.s.w.r.$ | typ. | 1.4: 1 | |
| $R_L = 15 \Omega$ (BS9321/1409) | | < | 1.8: 1 | |

→ Intermediate frequency impedance

| | | | | |
|---|----------|------|-------------|----------|
| $f = 34.86 GHz$, rectified current = 0.5 mA | Z_{if} | typ. | 900 | Ω |
| $R_L = 15 \Omega$, i.f. = 45 MHz (BS9321/1405) | | | 700 to 1100 | Ω |

| | | | | |
|----------------------------------|-----|--|----------|-----|
| <u>Operating frequency range</u> | f | | 26 to 40 | GHz |
|----------------------------------|-----|--|----------|-----|

MATCHED PAIRS

The diodes can be supplied in matched pairs under the type number 2/BAT59M. The diodes are matched to $\pm 10\%$ on rectified current and within 150Ω i.f. impedance.

¹⁾ Standard test holder.

MICROWAVE MIXER DIODES

BAV22 BAV22R

Coaxial Schottky barrier diodes for use in pre-tuned X- and S-band low noise mixer ← circuits. The diodes are suitable as replacements for most British coaxial point contact types in these bands, for example, GEM3, GEM4, CV7108, CV7109, CV2154 and CV2155. They conform to the environmental requirements of BS9300 where applicable. Available as a matched pair as 2/BAV22MR.

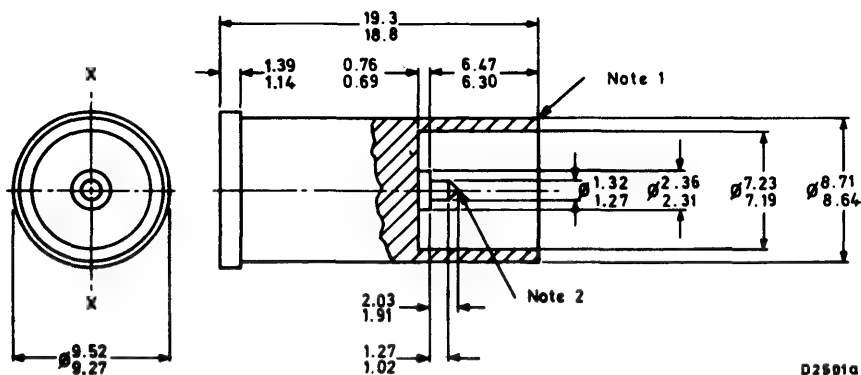
| QUICK REFERENCE DATA | | | |
|------------------------|------|-----|-----|
| Operating frequency | max. | 12 | GHz |
| Noise figure at X-band | typ. | 7.0 | dB |
| at S-band | typ. | 6.0 | dB |

Unless otherwise stated, data is applicable to both types.

MECHANICAL DATA

Dimensions in mm

Conforms to BS3934 SO-26



Terminal identification

BAV22 Pin cathode
Body (red spot) anode

BAV22R Pin anode
Body (green spot) cathode

Note 1. The device is designed to make contact on this open face

Note 2. Cone tapers to a radius 0.13 mm nominal

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|--|------|-----|
| Maximum peak pulse power (9.375GHz, 0.5 μ s pulse length) | 1.0 | W |
| Maximum burn-out | | |
| multiple r.f. spikes, $\Delta N_o = 1\text{dB}$ | 20 | nJ |
| | 0.2 | erg |
| 5000 d.c. spikes, $\Delta N_o = 1\text{dB}$ | 35 | nJ |
| | 0.35 | erg |

Temperature

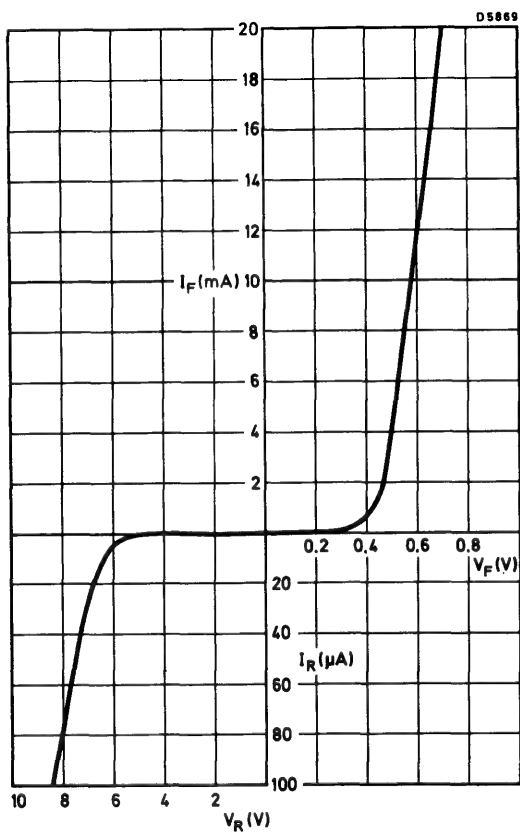
| | | |
|------------------------|-------------|--------------------|
| T_{stg} range | -55 to +100 | $^{\circ}\text{C}$ |
| T_{amb} range | -55 to +100 | $^{\circ}\text{C}$ |

ELECTRICAL CHARACTERISTICS ($T_{\text{amb}} = 25^{\circ}\text{C}$)

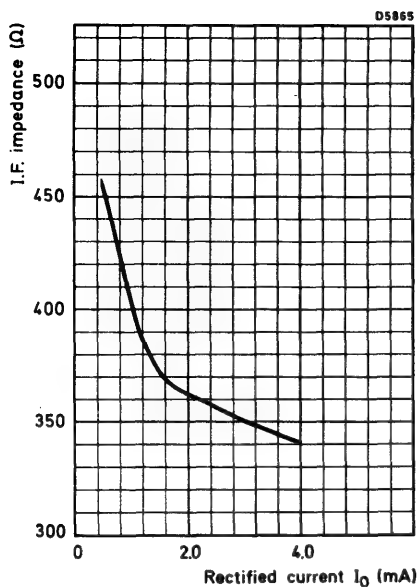
| | | Min. | Typ. | Max. | |
|-----------------|---|------|-------|--------|----------|
| N_o | Noise figure (see note 1) | - | 7.0 | 7.5 | dB |
| N_o | Noise figure (at 3GHz) | - | 6.0 | - | dB |
| v.s.w.r. | Voltage standing wave ratio (see note 2) | - | - | 1.43:1 | |
| v.s.w.r. | Voltage standing wave ratio (at 3GHz) | - | 1.2:1 | - | |
| Z_{if} | Intermediate frequency impedance (see note 3) | 300 | - | 550 | Ω |

NOTES

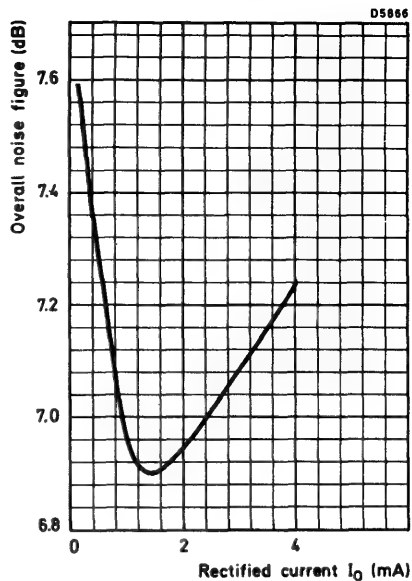
1. Measured at 9.375GHz, 1mA rectified current, $R_L = 15\Omega$. N_o includes $N_{\text{if}} = 1.5\text{dB}$ with 45MHz intermediate frequency. BS9321/1406.
2. With respect to CV2154 holder at 9.375GHz and 1mA rectified current, $R_L = 15\Omega$. BS9321/1409.
3. Measured at 9.375GHz, 1mA rectified current, $R_L = 15\Omega$, i.f. = 45MHz. BS9321/1405.



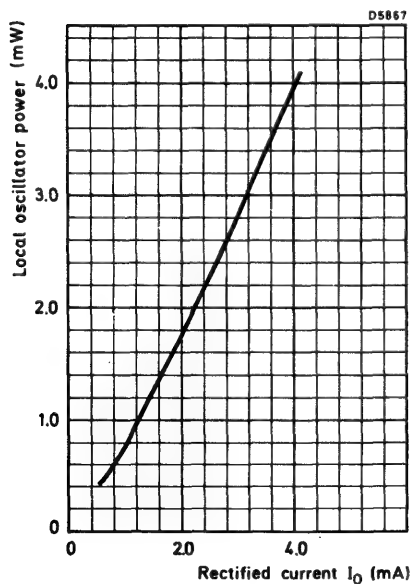
TYPICAL D.C. CHARACTERISTIC



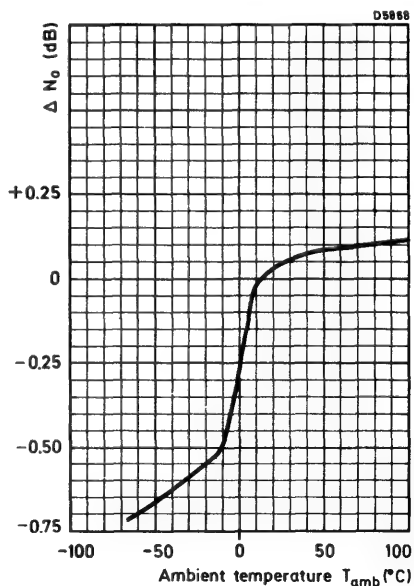
TYPICAL I. F. IMPEDANCE
AGAINST RECTIFIED CURRENT



TYPICAL OVERALL NOISE FIGURE
AGAINST RECTIFIED CURRENT



TYPICAL LOCAL OSCILLATOR POWER
AGAINST RECTIFIED CURRENT



TYPICAL CHANGE IN OVERALL NOISE
FIGURE AGAINST TEMPERATURE

X-BAND MIXER/DETECTOR DIODE

Silicon Schottky barrier diode in DO-23 (1N23) outline specially designed for use in Doppler radar systems and intruder alarms where low $1/f$ noise and high sensitivity are required. May be used for both mixer and detector applications.

QUICK REFERENCE DATA

Mixer mode

| | | | |
|---|------|-----|---------|
| Voltage output for -90 dBm input power at X-band | typ. | 40 | μ V |
| $1/f$ noise at a frequency 1 Hz to 1 kHz from carrier | typ. | 1.0 | μ V |

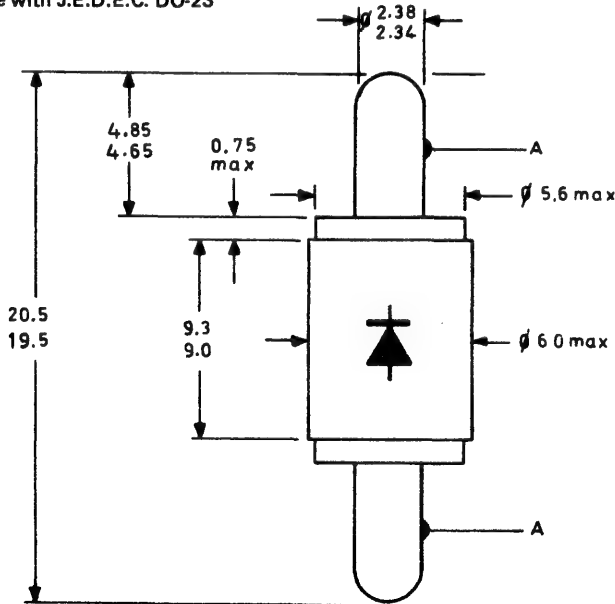
Detector mode

| | | | |
|--|------|-------|-----|
| Tangential sensitivity in bandwidth 0 to 2 MHz | typ. | -55 | dBm |
|--|------|-------|-----|

MECHANICAL DATA

Dimensions in mm

Compatible with J.E.D.E.C. DO-23

A = concentricity tolerance = ± 0.2

D4867a

Terminal identification: diode symbol indicates polarity

Accessory: collet type 56321 (see page 4) converts BAV46 to DO-22 outline



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

| | | | |
|---|-----------|-------------|----|
| Storage temperature range | T_{stg} | –20 to +100 | °C |
| Ambient temperature range for operation | T_{amb} | –20 to +100 | °C |
| Reverse voltage | V_R | max. 2 | V |
| Forward current | I_F | max. 10 | mA |

CHARACTERISTICS ($T_{amb} = 25\text{ °C}$)

| | | | |
|--|-------|----------|---------------|
| Forward voltage at $I_F = 1\text{ mA}$ | V_F | typ. 0.5 | V |
| Reverse current at $V_R = 2\text{ V}$ | I_R | max. 2 | μA |

Mixer mode

| | | | |
|--|-------|----------|---------------|
| Voltage output at X-band (notes 1 and 2) | V_o | min. 15 | μV |
| | V_o | typ. 40 | μV |
| $1/f$ noise (note 3) | N_f | typ. 1.0 | μV |
| | N_f | max. 2.0 | μV |

Detector mode

| | | | |
|---------------------------------|----------|----------|----------|
| Tangential sensitivity (note 4) | S_{ts} | min. –52 | dBm |
| | S_{ts} | typ. –55 | dBm |
| Video impedance (note 5) | Z_v | typ. 850 | Ω |

Notes

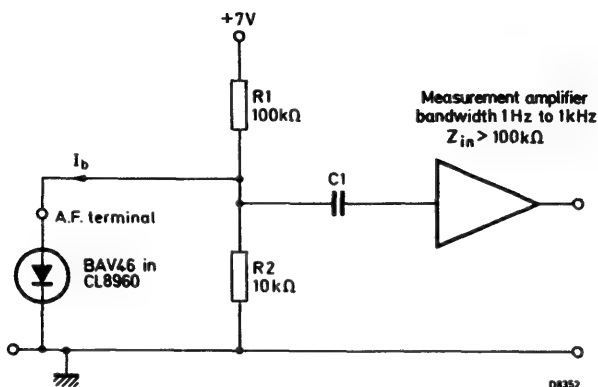
1. Mixer operated with d.c. bias of $35\text{ }\mu\text{A}$ and r.f. bias of -18 dBm , giving a total bias of $42\text{ }\mu\text{A}$.
2. Measurement made using Mullard CL8960 doppler radar module, output power 10 mW (typ.). The input power to the mixer of -90 dBm is a signal 100 dB down on the output power from a typical CL8960 with signal + noise at 18 dB (min.).

noise

A return signal, 100 dB down on radiated power, is equivalent to that achieved from a man target of radar cross-section 1.0 m^2 at a range of 15 m when operating the CL8960 with a 5 dB antenna.



Measurement circuit:



- N.B. a) The current I_b should be approximately $35 \mu\text{A}$ with the Gunn device disconnected and approximately $42 \mu\text{A}$ with the Gunn device operational and the antenna operating into free space.
- b) The coupling capacitor C_1 should have a small impedance compared with Z_{in} .
- Noise measured at a frequency 1 Hz to 1 kHz from carrier with a d.c. bias of $50 \mu\text{A}$.
 - Bandwidth 0 to 2 MHz and a forward bias of $50 \mu\text{A}$.
 - Measured with a forward bias of $50 \mu\text{A}$.

OPERATING NOTES

Care must be taken when making measurements that the precautions described in the operating notes are observed and that test equipment does not introduce transients.

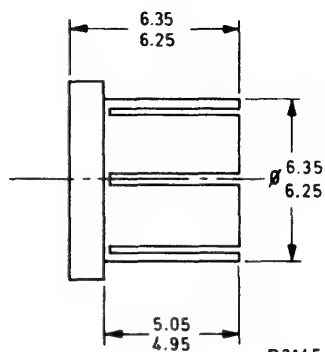
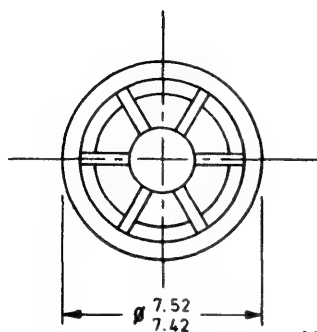
- The mixer diode has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from the mains supply when soldering to the user's mixer a.f. terminals.
- Precautions similar to those required for CMOS devices are necessary, namely:
 - Earthed wrist straps should be worn.
 - Table tops or other working surfaces should be conductive and earthed.
 - Anti-static clothing should be worn.
 - To prevent the development of damaging transient voltages, the device should not be inserted or removed from the user's circuit with the d.c. power applied.
- It is recommended that the user incorporates a mixer protection circuit. A suitable circuit consists of two BA317 diodes connected in parallel but with one diode reversed, together with a parallel 10 nF capacitor. This circuit should be connected in close proximity to the mixer a.f. and earth terminals and has been found to afford a suitable degree of protection.
- A d.c. bias level of at least $30 \mu\text{A}$ must be maintained to ensure adequate mixer performance. It may be increased to $100 \mu\text{A}$ without affecting sensitivity or noise level.



BAV46

COLLET 56321

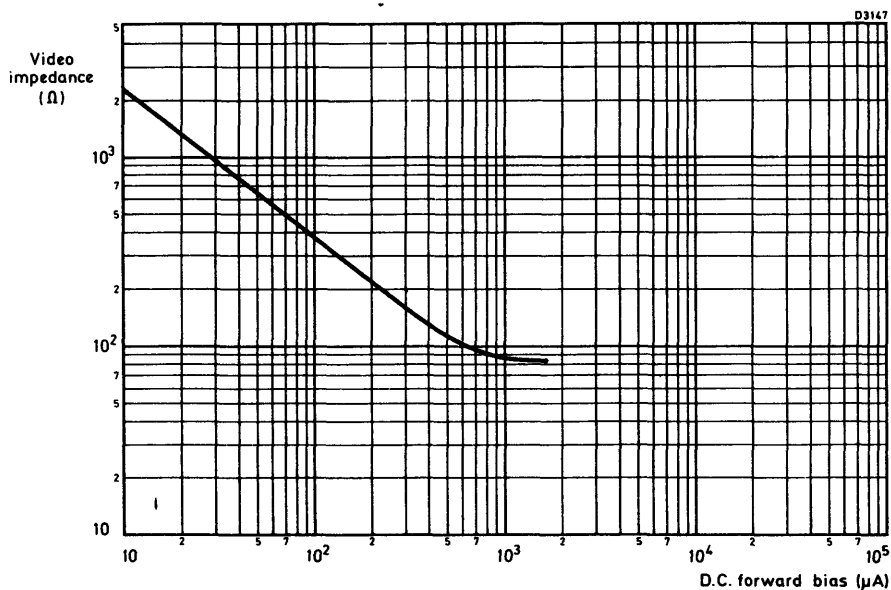
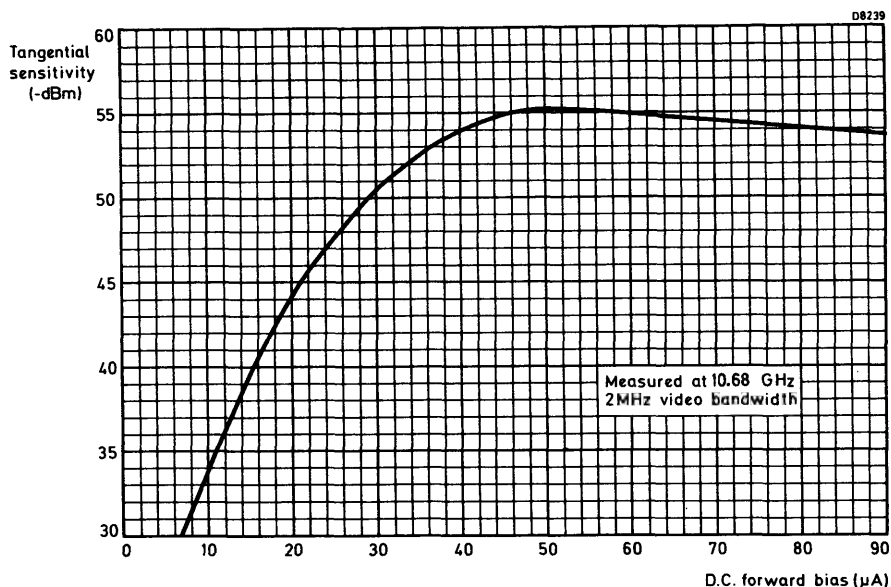
Dimensions in mm



All dimensions in mm

D3145





MICROWAVE MIXER DIODE

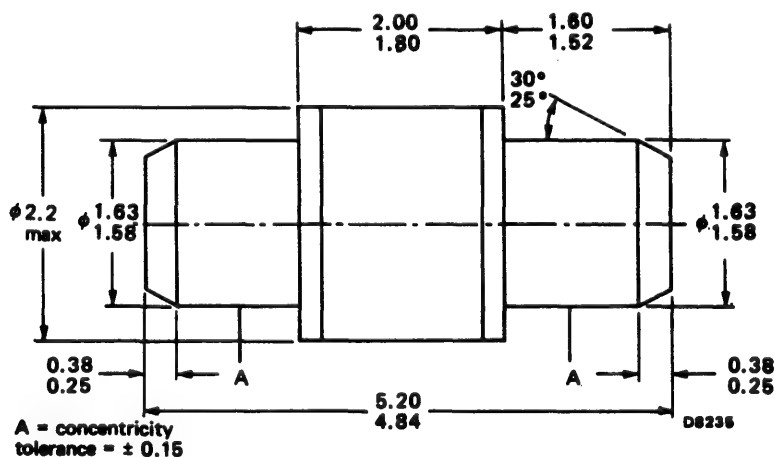
Silicon Schottky barrier mixer diode for use in low noise mixer applications in Q-band. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

| | | | |
|-----------------|------|----------|-----|
| Frequency range | | 26 to 40 | GHz |
| Noise figure | max. | 10 | dB |

MECHANICAL DATA

Dimensions in mm



Terminal identification: red end indicates cathode

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| | | | | |
|--------------------------------|-----------|------|-------------|-----|
| Burn-out (r.f. spike) (note 1) | | max. | 0.04 | erg |
| Burn-out, peak pulse power | | max. | 1.0 | W |
| Storage temperature range | T_{stg} | | -55 to +150 | °C |
| Ambient temperature range | T_{amb} | | -55 to +150 | °C |

CHARACTERISTICS

 $T_{amb} = 25\text{ °C}$

Static

| | | | | |
|--|-------|------|-----|---------------|
| Reverse current ($V_R = 0.5\text{ V}$) | I_R | max. | 0.2 | μA |
| Forward current ($V_F = 0.5\text{ V}$) | I_F | min. | 0.5 | mA |

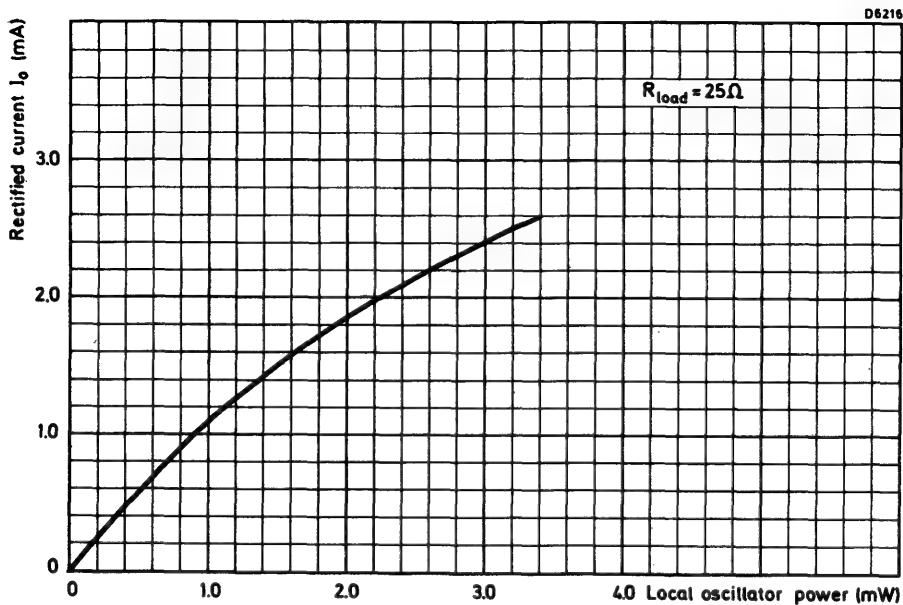
Dynamic

| | | | | |
|---|------------|------|-------|----------|
| Noise figure (note 2) | N_O | max. | 10 | dB |
| Voltage standing wave ratio (note 3) | v.s.w.r. | max. | 1.8:1 | |
| Intermediate frequency impedance (note 4) | $Z_{i.f.}$ | min. | 700 | Ω |
| | | max. | 1100 | Ω |
| Frequency range | f | min. | 26 | GHz |
| | | max. | 40 | GHz |
| Conversion loss (note 5) | L_c | typ. | 5.9 | dB |
| Noise temperature ratio (note 6) | N_r | typ. | 1.4:1 | |

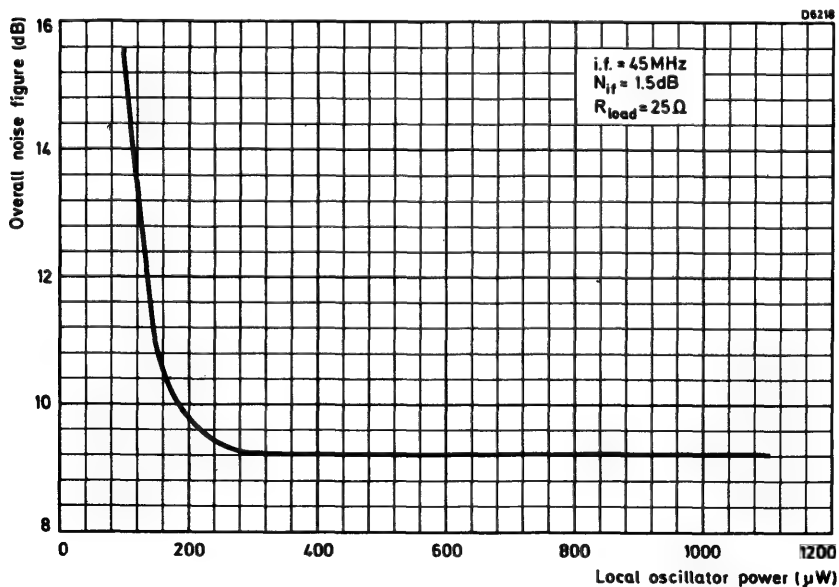
Notes

1. Local oscillator frequency = 9.375 GHz, number of pulses = 6×10^5 , pulse duration = 2 ns at half peak energy, p.r.f. = 2000 p.p.s., load resistance = 0 Ω . $T_{amb} = 25\text{ °C}$.
2. Measured with a local oscillator frequency of 34.86 GHz, $I_O = 0.5\text{ mA}$, load resistance = 15 Ω , i.f. = 45 MHz, BS9300 No.1406.
3. Measured with a local oscillator frequency of 34.86 GHz, $I_O = 0.5\text{ mA}$, load resistance = 15 Ω , BS9300 No.1409.
4. Measured with a local oscillator frequency of 34.86 GHz, $I_O = 0.5\text{ mA}$, load resistance = 15 Ω , i.f. = 45 MHz, BS9300 No.1405.
5. Measured at 34.86 GHz, 450 μW local oscillator power level and load resistance = 1 k Ω .
6. Measured at 34.86 GHz and i.f. = 45 MHz.
7. The diodes are measured in fixed tuned Q-band waveguide mounts. Details may be obtained from Mullard Ltd.





Typical rectified current as a function of local oscillator power at 34.86 GHz



Typical overall noise figure as a function of local oscillator power at 34.86 GHz



**MICROWAVE
DETECTOR DIODE**

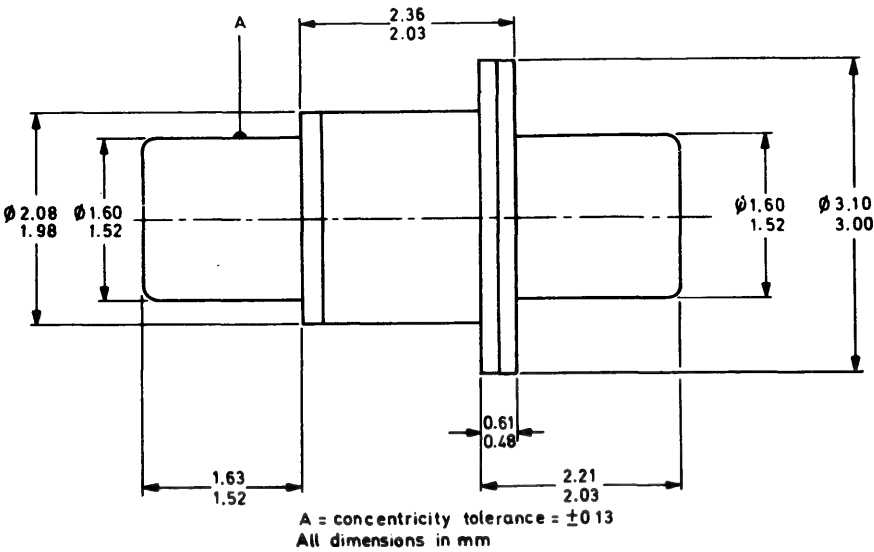
BAV75

Silicon Schottky barrier diode in SO-86 outline, specially designed for use in doppler radars where high detector sensitivity is required. It conforms to the environmental requirements of BS9300 where applicable.

| QUICK REFERENCE DATA | | |
|---|-----------|-----|
| Frequency range | 8.0 to 12 | GHz |
| Tangential sensitivity (typ.) with 100 μ A bias | -50 | dBm |

OUTLINE AND DIMENSIONS

Conforms to B. S. 3934 SO-86



05476

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

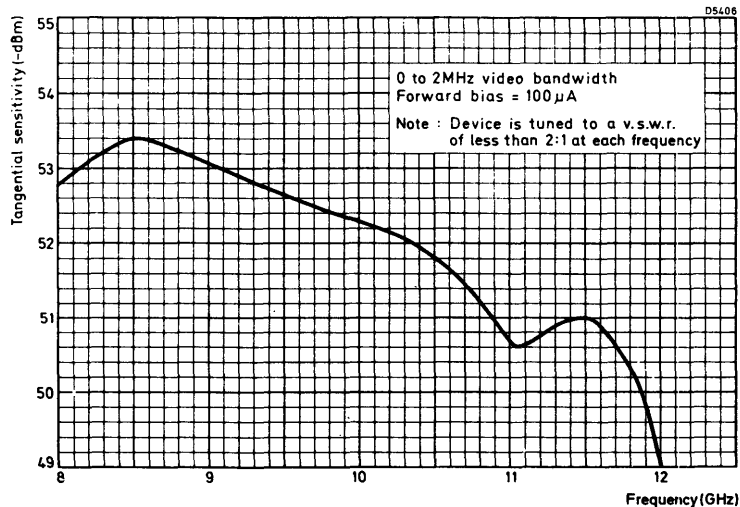
| | | |
|--------------------------------------|-------------|--------------|
| Peak pulse power (max.) at 9.375 GHz | | |
| 0.5 μ s pulse length | 0.75 | W |
| Temperature | | |
| T _{stg} range | -55 to +150 | $^{\circ}$ C |
| T _{amb} range | -55 to +150 | $^{\circ}$ C |

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25 $^{\circ}$ C)

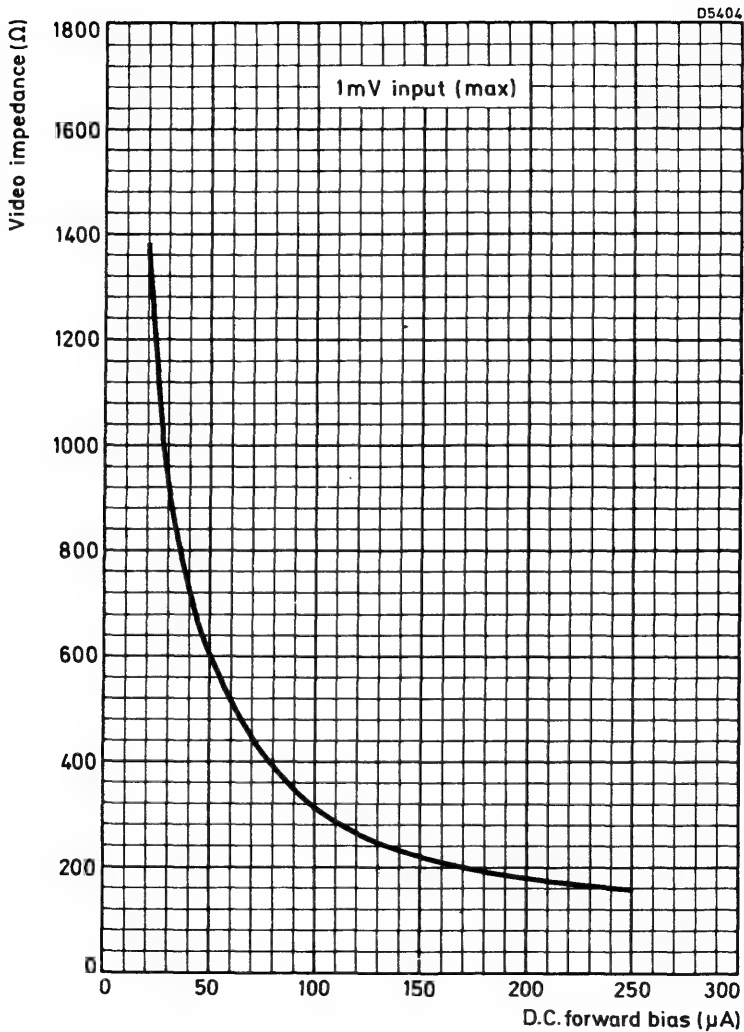
| | | min. | typ. | max. |
|-----------------|--|------|------|----------|
| v.s.w.r. | Voltage standing wave ratio (see notes 1, 2, and 3) | | 2:1 | |
| Z _v | Video impedance (see notes 4 and 5) | | 310 | Ω |
| S _{ts} | Tangential sensitivity (see notes 1 and 2) | -49 | -50 | dBm |
| 1/f | Flicker noise (see notes 4 and 6) | | 10 | 15 dB |

NOTES

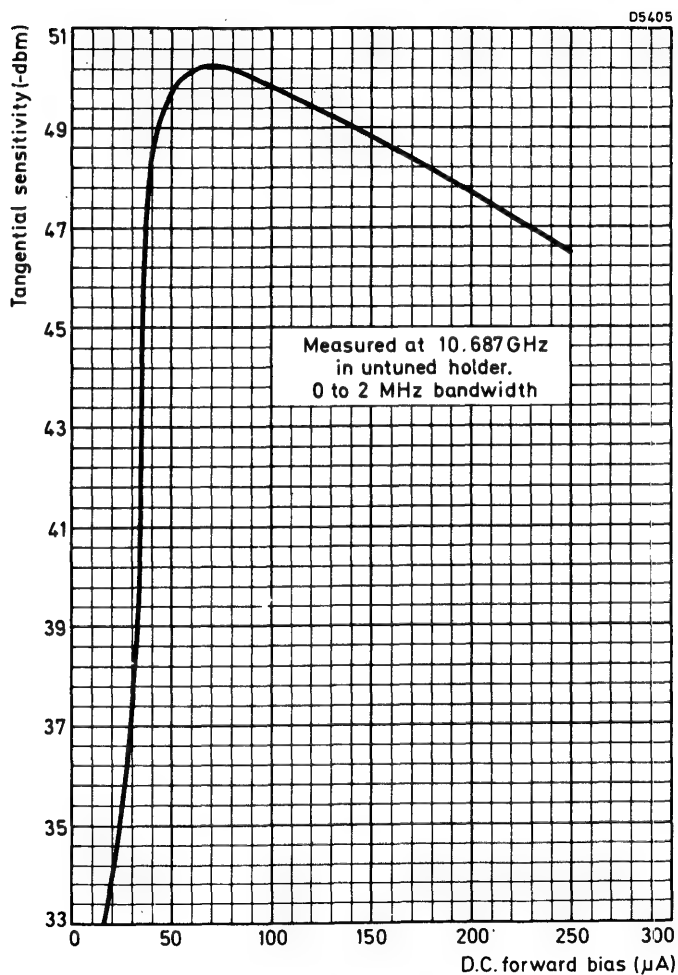
1. Measured at 10.687 GHz with 100 μ A forward bias.
2. Measured in a reduced height waveguide mount, (Sanders 6521, modified).
3. R. F. input power less than 5.0 μ W.
4. Measured with 100 μ A forward bias.
5. Maximum d. c. input voltage = 1.0mV.
6. a) Measured at an i. f. of 1kHz with 50Hz bandwidth.
b) 1/f noise remains constant with a forward bias not exceeding 250 μ A.



TANGENTIAL SENSITIVITY AS A FUNCTION OF FREQUENCY



VIDEO IMPEDANCE AS A FUNCTION OF D.C. FORWARD BIAS



TANGENTIAL SENSITIVITY AS A FUNCTION OF D.C. FORWARD BIAS

MICROWAVE MIXER DIODES

**BAV96A
BAV96B
BAV96C
BAV96D**

A range of sub-miniature reversible low noise Schottky barrier mixer diodes. The planar technology employed imparts a high degree of reliability and reproducibility. The metal-ceramic case is hermetically sealed and the devices conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

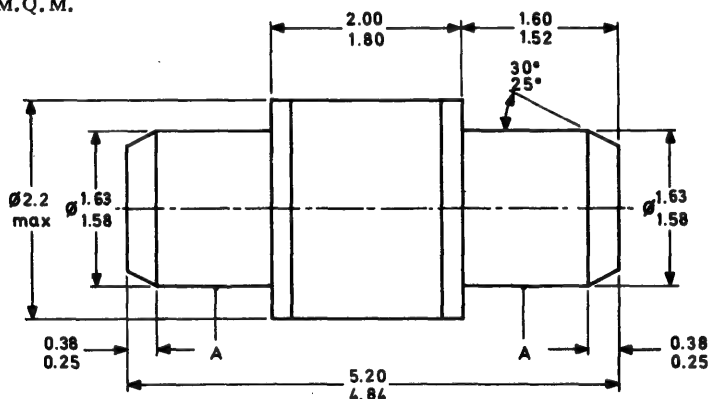
Maximum noise figure in X-band

| | | |
|--------|-----|----|
| BAV96A | 7.5 | dB |
| BAV96B | 7.0 | dB |
| BAV96C | 6.5 | dB |
| BAV96D | 6.0 | dB |

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

M. Q. M.



All dimensions in mm

A = concentricity tolerance = ± 0.15

D1654e

Terminal identification: red end indicates cathode

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Maximum burn out (see note 1)

| | |
|------|-----|
| 15 | nj |
| 0.15 | erg |

RATINGS (ABSOLUTE MAXIMUM SYSTEM) (Contd.)

Temperature

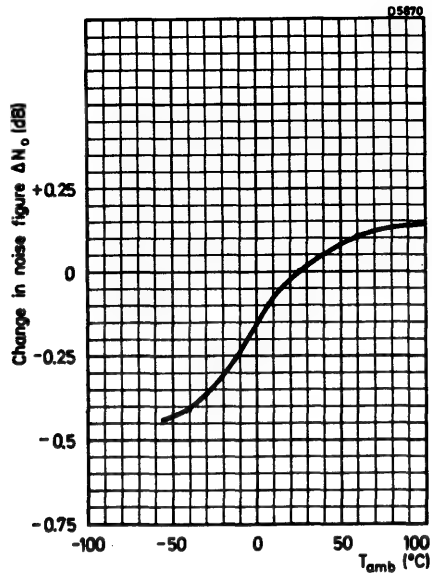
| | | |
|-----------------|-------------|----|
| T_{stg} range | -55 to +150 | °C |
| T_{amb} range | -55 to +150 | °C |

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$)

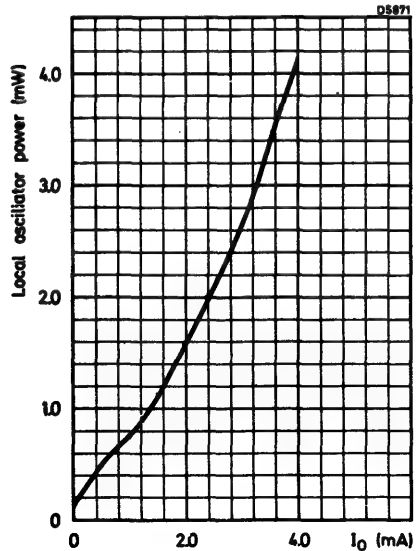
| N_o noise figure (see note 2) | Min. | Typ. | Max. | |
|--|------|--------|--------|----------|
| BAV96A | - | 7.0 | 7.5 | dB |
| BAV96B | - | 6.5 | 7.0 | dB |
| BAV96C | - | 6.0 | 6.5 | dB |
| BAV96D | - | 5.5 | 6.0 | dB |
| v. s. w. r. (see note 3) | | | | |
| BAV96A | - | 1.7: 1 | 2.0: 1 | |
| BAV96B | - | 1.4: 1 | 1.6: 1 | |
| BAV96C | - | 1.4: 1 | 1.6: 1 | |
| BAV96D | - | 1.3: 1 | 1.5: 1 | |
| Z_{if} i. f. impedance (see note 4) | 250 | - | 450 | Ω |
| S_{ts} tangential sensitivity (see note 5) | - | -52 | - | dBm |
| S_{ts} (see note 6) | - | -54 | - | dBm |

NOTES

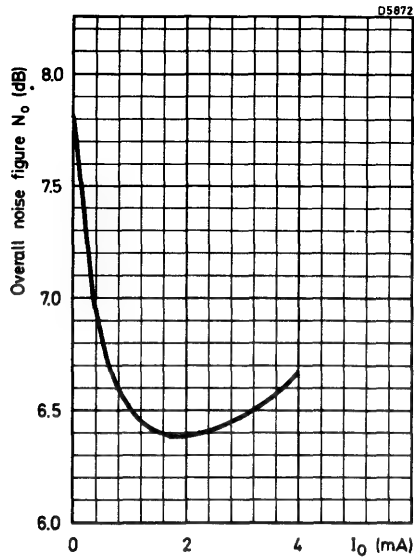
1. Burn out is defined as the r. f. pulse energy necessary to cause 1dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2ns width.
2. Measured at $9.375 \pm 0.1\text{GHz}$. The noise figure includes i. f. amplifier contribution of 1.5dB, i. f. 45MHz, d. c. return for diode 15Ω max. , rectified current 1mA. BS9321/1406.
3. Measured in a reduced height waveguide mount under the same test conditions as in note 2. BS9321/1409.
4. I. F. = 45MHz, $R_L = 15\Omega$, $f = 9.375 \pm 0.1\text{GHz}$, $I_o = 1\text{mA}$. BS9321/1405.
5. Video bandwidth 0 to 2MHz, $30\mu\text{A}$ bias. BS9322/1411.
6. Video bandwidth 1kHz to 1MHz, $30\mu\text{A}$ bias. BS9322/1411.
7. A suitable holder for this diode is a modified version of Sanders type 6521.



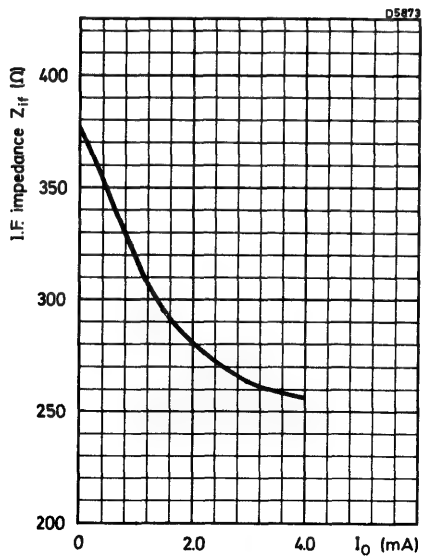
**TYPICAL CHANGE IN OVERALL NOISE FIGURE
AS A FUNCTION OF TEMPERATURE**



**TYPICAL LOCAL OSCILLATOR POWER
AS A FUNCTION OF RECTIFIED CURRENT**



TYPICAL OVERALL NOISE FIGURE AS A FUNCTION OF
RECTIFIED CURRENT



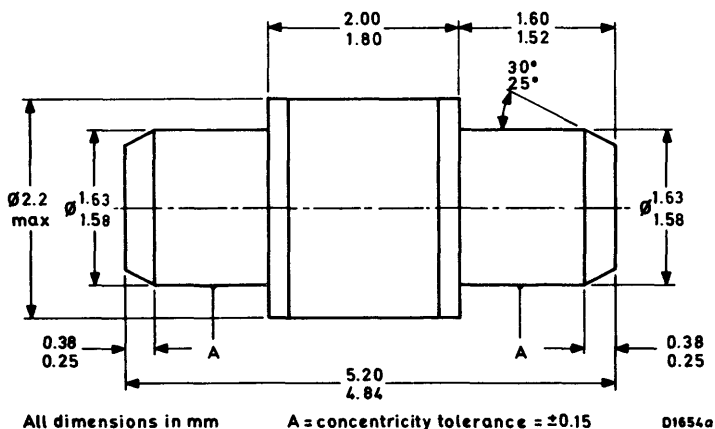
TYPICAL I. F. IMPEDANCE AS A FUNCTION OF
RECTIFIED CURRENT

BAV97

The metal ceramic case is hermetically sealed.

| QUICK REFERENCE DATA | | | |
|----------------------|--------------------------------|-----|-----|
| S_{TS} | Tangential sensitivity (typ.) | -54 | dBm |
| $\frac{1}{f}$ | noise (typ.) | 10 | dB |

M.Q.M.



Terminal identification: red end indicates cathode

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

Maximum burn out (see note 1)

18 nJ
0.18 erg

Temperature

T_{stg} range

-55 to +150 °C

T_{amb} range

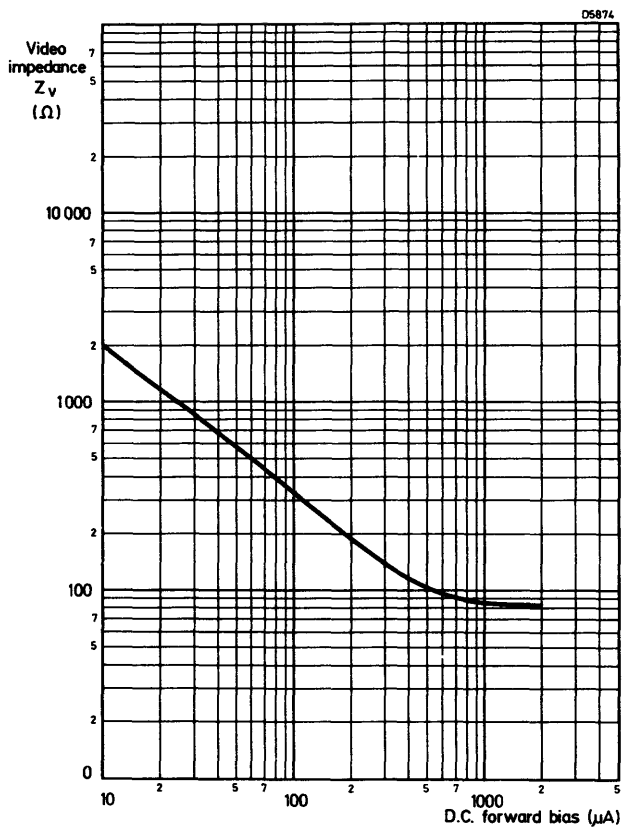
-55 to +150 °C

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

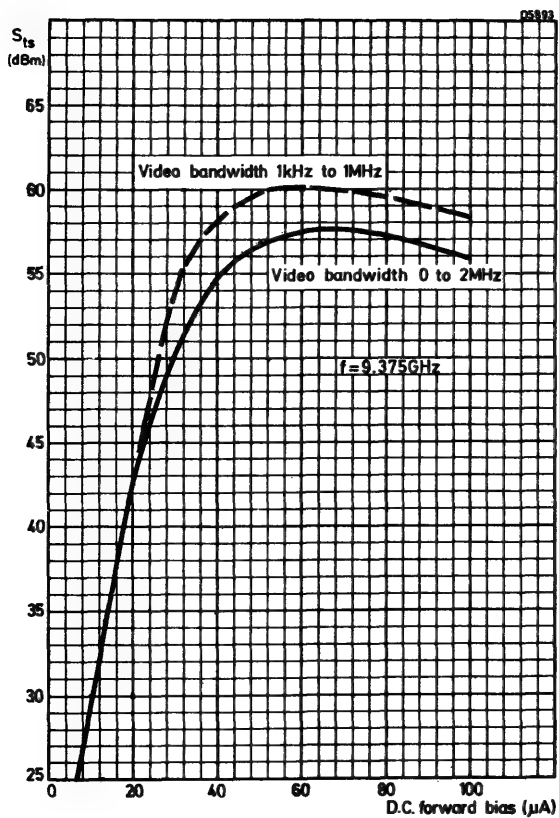
| | | Min. | Typ. | Max. | |
|-----------------|-------------------------------------|------|------|------|-----|
| S _{ts} | tangential sensitivity (see note 2) | -52 | -54 | -58 | dBm |
| $\frac{1}{f}$ | noise (see note 3) | - | 10 | 15 | dB |
| Z _v | video impedance (see note 4) | - | 500 | - | Ω |

NOTES

1. Burn out is defined as the r.f. pulse energy necessary to cause 1dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2ns width.
2. Video bandwidth 0 to 2MHz, 50μA bias, f = 9.375GHz. BS9322/1411. (A 2dBm improvement in tangential sensitivity may be obtained by limiting the bandwidth to 1kHz to 1MHz).
3. Measured at 30μA bias, f = 1kHz, 50Hz bandwidth. $\frac{1}{f}$ noise is unchanged with values of bias up to 150μA.
4. Measured at 50μA forward bias.



VIDEO IMPEDANCE AS A FUNCTION OF D.C. FORWARD BIAS



TANGENTIAL SENSITIVITY AS A FUNCTION OF D. C. FORWARD BIAS

MICROWAVE MIXER DIODES

**BAW95D
BAW95E
BAW95F
BAW95G**

A range of silicon Schottky barrier mixer diodes in reversible cartridge outline. ←
The diodes are suitable as replacements for the 1N23 and 1N415 series and conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Maximum noise figure at X-band

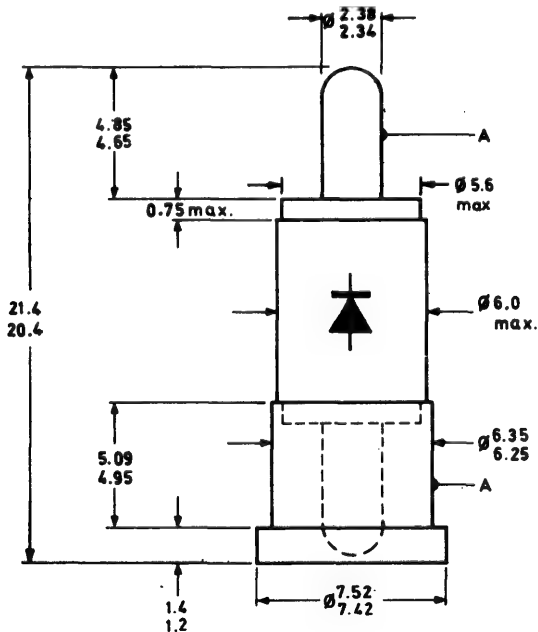
| | | |
|--------|-----|----|
| BAW95D | 8.2 | dB |
| BAW95E | 7.5 | dB |
| BAW95F | 7.0 | dB |
| BAW95G | 6.5 | dB |

Unless otherwise stated, data is applicable to all types

OUTLINE AND DIMENSIONS

Compatible with J.E.D.E.C. DO-22 with collet

Compatible with J.E.D.E.C. DO-23 without collet



A = concentricity tolerance = ± 0.2

All dimensions in mm.

D4868

Terminal identification: Diode symbol indicates polarity.

Mullard

LIMITING VALUES (Absolute max. rating system)

Electrical

| | | |
|---|-----|-----|
| Maximum peak pulse power (at 9.375 GHz, 0.5 μ s pulse length) | 1.0 | W |
| → Maximum burn out ¹⁾ | 20 | nJ |
| | 0.2 | erg |

Temperature

| | | |
|------------------------|-------------|----|
| T _{stg} range | -55 to +150 | °C |
| T _{amb} range | -55 to +150 | °C |

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C)

| | | Min. | Typ. | Max. | |
|-----------------|--|------|------|-------|----------|
| N ₀ | Noise figure ²⁾ | | | | |
| | BAW95D | - | 7.8 | 8.2 | dB |
| | BAW95E | - | 7.2 | 7.5 | dB |
| | BAW95F | - | 6.8 | 7.0 | dB |
| | BAW95G | - | 6.3 | 6.5 | dB |
| v.s.w.r. | Voltage standing wave ratio ³⁾ | - | - | 1.3:1 | |
| Z _{if} | Intermediate frequency impedance ⁴⁾ | 250 | 415 | 500 | Ω |

¹⁾ Burn out is defined as the r.f. pulse energy necessary to cause 1 dB degradation in noise figure when the diode is subjected to 2×10^8 pulses of 2 ns width

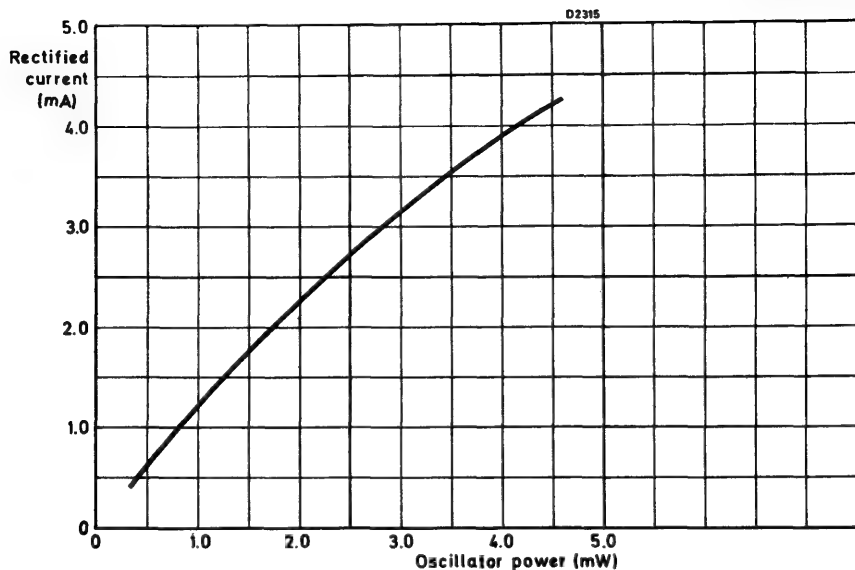
²⁾ Measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω . N₀ includes N_{if} = 1.5 dB with 45 MHz intermediate frequency. BS9321/1406

³⁾ With respect to JAN-106 holder measured at 9.375 GHz, 1 mA rectified current, R_L = 15 Ω . BS9321/1409

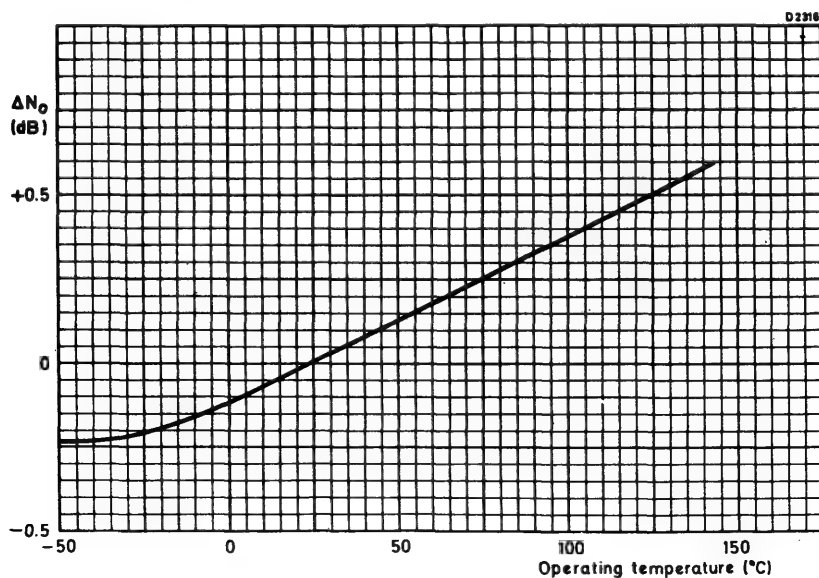
⁴⁾ Measured at 9.375 GHz. 1 mA rectified current, R_L = 15 Ω with 45 MHz intermediate frequency. BS9321/1405

MICROWAVE MIXER DIODES

BAW95D
BAW95E
BAW95F
BAW95G

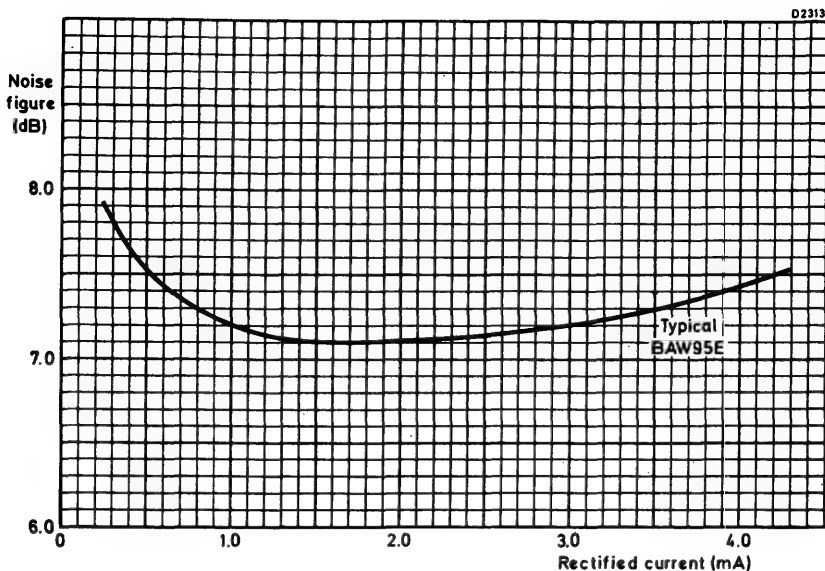


TYPICAL RECTIFIED CURRENT AS A FUNCTION OF LOCAL OSCILLATOR POWER

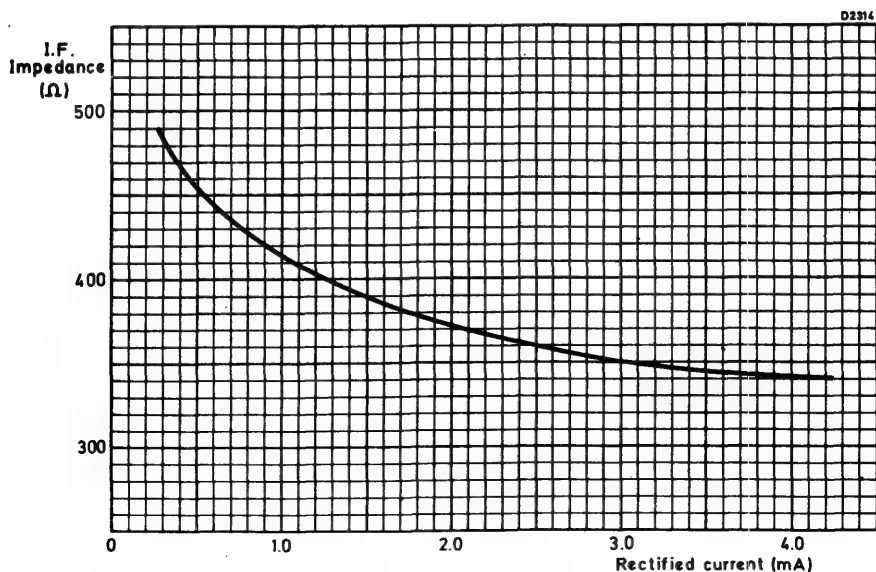


TYPICAL CHANGE IN NOISE FIGURE WITH TEMPERATURE

Mullard



TYPICAL NOISE FIGURE AS A FUNCTION OF RECTIFIED CURRENT



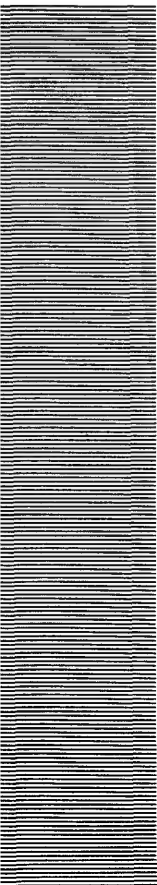
TYPICAL DEPENDENCE OF I. F. IMPEDANCE ON RECTIFIED CURRENT

BACKWARD DIODES

D



D



MICROWAVE DETECTOR DIODE

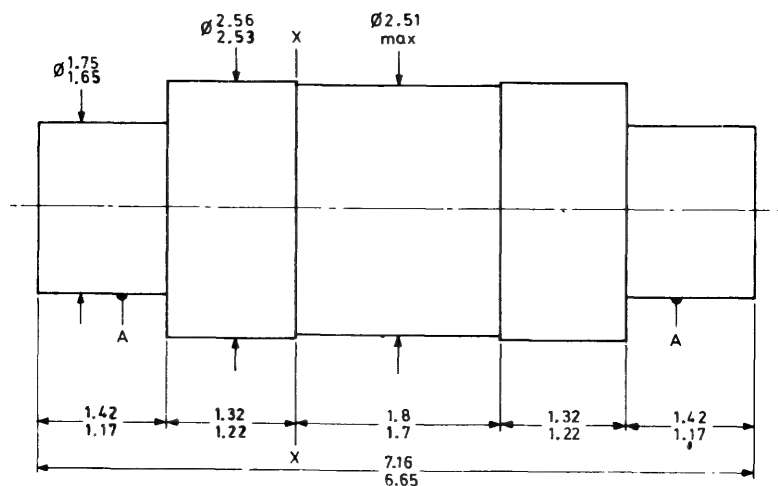
AEY17

Sub-miniature germanium bonded backward diode primarily intended for broad-band low level detector applications at X-band. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

| | | |
|---|---------|-----|
| Frequency range | 1 to 18 | GHz |
| Typ. zero bias tangential sensitivity in X-band | -53 | dBm |

OUTLINE AND DIMENSIONS



XX = reference plane

All dimensions in mm

D2527a

AA = concentricity tolerance = ± 0.15

TERMINAL IDENTIFICATION

The AEY17 is colour coded according to K1007 Issue 3, Section 1.3.4.4.

That is: the positive end (cathode) is marked red and the negative end (anode) is marked blue.

The positive end indicates the electrode which becomes positive in an a.c. rectifier circuit.

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RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Temperature

| | | |
|------------------------|-----|----|
| $T_{stg} \text{ max.}$ | 150 | °C |
| $T_{stg} \text{ min.}$ | -55 | °C |
| $T_{amb} \text{ max.}$ | 150 | °C |
| $T_{amb} \text{ min.}$ | -55 | °C |

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$)

| | | Min. | Typ. | Max. | |
|--|--|------|------|------|---------------|
| Static | | | | | |
| I_R | Reverse current | | | | |
| | $V_R = 0.3\text{V}$ | - | 100 | - | μA |
| I_F | Forward current | | | | |
| | $V_F = 0.3\text{V}$ | - | 12 | - | mA |
| Dynamic | | | | | |
| S_{ts} | Tangential sensitivity (see note 1) | - | -53 | - | dBm |
| M | Figure of merit (see note 2) | 120 | - | - | |
| Z_v | Video impedance (see note 3) | - | 300 | - | Ω |
| v.s.w.r. Voltage standing wave ratio (see note 4) | | - | - | 5:1 | |

Notes:

1. Measured at 9.375GHz, zero bias, video bandwidth = 1.0MHz. K1007 Issue 3, Section 8B.4.3.
2. Measured at 9.375GHz, M is taken as the product of current sensitivity expressed in μA per μW , and the square root of video impedance in ohms. K1007 Issue 3, Section 8B.4.2.
3. Zero bias, input 1.0mV max. (d.c. or a.c. r.m.s.). K1007 Issue 3, Section 8B.4.8.
4. With respect to 50 Ω , measured at $f = 9.375\text{GHz}$, zero bias and c.w. input power less than 1.0 μW . The nominal rectifier admittance at a reference plane X-X taken at the end faces of the ceramic insulator (see outline drawing on page 1) is:

$$(2.0 - j 2.0) \frac{1}{50} \text{ mho}$$

APPLICATION INFORMATION FOR AEY17

1. Detector performance at other than Test Radio Frequency

| | | Min. | Typ. | Max. |
|----------|---|------|------|-------|
| S_{ts} | Tangential sensitivity | | | |
| | $f = 1.0$ to 18GHz , $B = 1.0\text{MHz}$ | - | -53 | - dBm |
| v.s.w.r. | Voltage standing wave ratio | | | |
| | $f = 1.0$ to 18GHz , $Z_o = 50\Omega$ | - | - | 5:1 |

2. Mixer performance (I.F. = 45MHz)

| | | | | |
|----------|--|---|-----|------------|
| N_o | Measured overall noise figure | | | |
| | $f = 9.375\text{GHz}$, $N_{if} = 1.5\text{dB}$ | | | |
| | $P_{L.O.} = 200\mu\text{W}$, $I_{out} = 1.0\text{mA}$ | - | 9.0 | - dB |
| | $f = 16.5\text{GHz}$, $N_{if} = 1.5\text{dB}$ | | | |
| | $P_{L.O.} = 200\mu\text{W}$, $I_{out} = 1.0\text{mA}$ | - | 9.5 | - dB |
| Z_{if} | I.F. impedance | | | |
| | $I_{out} = 1.0\text{mA}$ | - | 130 | - Ω |
| v.s.w.r. | Voltage standing wave ratio | | | |
| | $f = 1$ to 18GHz , $Z_o = 50\Omega$ | | | |
| | $I_{out} = 1.0\text{mA}$ | - | - | 2.5:1 |

3. Doppler mixer performance (I.F. = 3kHz)

| | | | | |
|-------|---|---|----|------|
| N_o | Measured overall noise figure | | | |
| | $f = 9.375\text{GHz}$, $N_{if} = 2.0\text{dB}$ | - | 18 | - dB |

MICROWAVE DETECTOR DIODES

AEY29
AEY29R

Germanium bonded backward diodes primarily intended for low level detector applications at J-band (Ku band). The AEY29 and AEY29R are packaged in the standard coaxial outline for this frequency band, similar to 1N78 types. The encapsulation is hermetically sealed and the devices conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

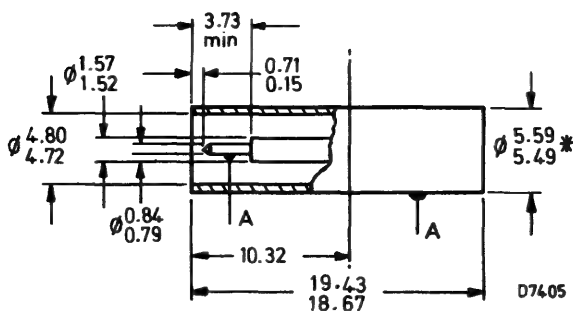
| | | |
|---|----------|-----|
| Frequency range | 12 to 18 | GHz |
| Typ. zero bias tangential sensitivity at J-band | -53 | dBm |

Unless otherwise stated, data is applicable to both types

MECHANICAL DATA

Dimensions in mm

DO-37



A = concentricity tolerance = ± 0.35

*These limits apply only over 10.32 dimensions

TERMINAL IDENTIFICATION

AEY29 Pin cathode
Body (red) anode

AEY29R Pin anode
Body (green) cathode

→ RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Temperature

| | | |
|----------------|-----|----|
| T_{stg} min. | -55 | °C |
| T_{stg} max. | +85 | °C |
| T_{amb} min. | -55 | °C |
| T_{amb} max. | +85 | °C |

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$)

| Static | | Min. | Typ. | Max. | |
|----------|---|------|------|------|---------------|
| I_R | Reverse current $V_R = 0.3\text{V}$ | - | 100 | - | μA |
| I_F | Forward current $V_F = 0.3\text{V}$ | - | 12 | - | mA |
| Dynamic | | | | | |
| S_{ts} | Tangential sensitivity (see note 1) | - | -53 | - | dBm |
| M | Figure of merit (see note 2) | 50 | - | - | |
| Z_v | Video impedance (see note 3) | - | 300 | - | Ω |
| v.s.w.r. | Voltage standing wave ratio (see note 4) | - | - | 5:1 | |

Notes :

1. Measured at 16.5GHz in JAN201 holder, zero bias, 1.0MHz video bandwidth. (K1007 Issue 3, Section 8B.4.3.).
2. Measured at 16.5GHz in JAN201 holder, M is taken as the product of current sensitivity expressed in μA per μW , and the square root of video impedance in ohms. (K1007 Issue 3, Section 8B.4.2.).
3. Zero bias, input 1.0mV max. (d.c. or a.c. r.m.s.). (K1007 Issue 3, Section 8B.4.8.).
4. With respect to JAN201 holder, measured at $f = 16.5\text{GHz}$, zero bias and c.w. input power less than $1.0\mu\text{W}$.

MICROWAVE DETECTOR DIODES

AEY31 AEY31A

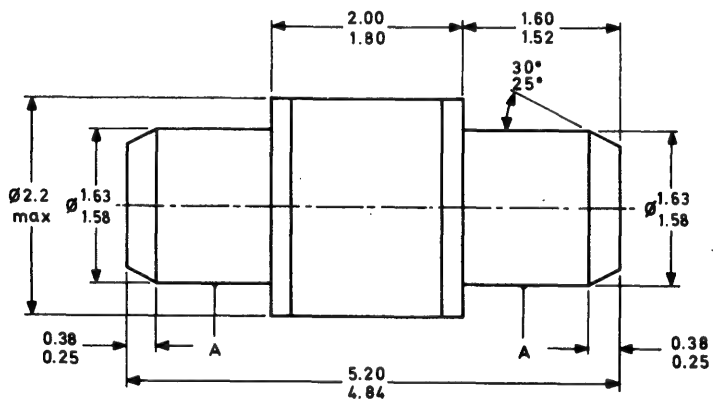
Sub-miniature germanium bonded backward diodes primarily intended for broad-band low level detector applications at X-band. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

| | | |
|---|---------|-----|
| Frequency range | 1 to 18 | GHz |
| Typ. zero bias tangential sensitivity at X-band | | |
| AEY31 | -53 | dBm |
| AEY31A | -50 | dBm |

Unless otherwise stated, data is applicable to both types

OUTLINE AND DIMENSIONS



All dimensions in mm

A = concentricity tolerance = ± 0.15

D1654

TERMINAL IDENTIFICATION

The AEY31 and AEY31A are colour coded according to K1007 Issue 3, Section 1. 3. 4. 4. That is: the positive end (cathode) is marked red and the negative end (anode) is marked blue.

The positive end indicates the electrode which becomes positive in an a. c. rectifier circuit.

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RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Temperature

| | | |
|----------------|-----|-------------|
| T_{stg} max. | 150 | $^{\circ}C$ |
| T_{stg} min. | -55 | $^{\circ}C$ |
| T_{amb} max. | 150 | $^{\circ}C$ |
| T_{amb} min. | -55 | $^{\circ}C$ |

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}C$)

| | | Min. | Typ. | Max. | |
|----------------|---|------|------|------|----------|
| Static | | | | | |
| I_R | Reverse current | | | | |
| | $V_R = 0.3V$ | - | 100 | - | μA |
| I_F | Forward current | | | | |
| | $V_F = 0.3V$ | - | 12 | - | mA |
| Dynamic | | | | | |
| S_{ts} | Tangential sensitivity (see note 1) | | | | |
| | AEY31 | - | -53 | - | dBm |
| | AEY31A | - | -50 | - | dBm |
| M | Figure of merit (see note 2) | | | | |
| | AEY31 | 120 | - | - | |
| | AEY31A | 50 | - | - | |
| Z_v | Video impedance (see note 3) | - | 300 | - | Ω |
| v.s.w.r. | Voltage standing wave ratio (see note 4) | - | - | 5:1 | |

Notes:

1. Measured at 9.375GHz, zero bias, video bandwidth = 1.0MHz. K1007 Issue 3, Section 8B.4.3.
2. Measured at 9.375GHz, M is taken as the product of current sensitivity expressed in μA per μW , and the square root of video impedance in ohms. K1007 Issue 3, Section 8B.4.2.
3. Zero bias, input 1.0mV max. (d.c. or a.c. r.m.s.). K1007 Issue 3, Section 8B.4.8.
4. With respect to 50 Ω , measured at $f = 9.375GHz$, zero bias and c.w. input power less than 1.0 μW . The nominal rectifier admittance at a reference plane X-X taken at the end faces of the ceramic insulator (see outline drawing on page 1) is:

$$(2.0 - j 2.0) \frac{1}{50} \text{ mho}$$

MICROWAVE DETECTOR DIODES

AEY31 AEY31A

APPLICATION INFORMATION FOR AEY31 AND AEY31A

1. Detector performance at other than Test Radio Frequency

| | | Min. | Typ. | Max. | |
|----------|---|------|------|------|-----|
| S_{ts} | Tangential sensitivity | | | | |
| | $f = 1.0$ to 18GHz , $B = 1.0\text{MHz}$ | | | | |
| | AEY31 | - | -53 | - | dBm |
| | AEY31A | - | -50 | - | dBm |
| | v.s.w.r. Voltage standing wave ratio | | | | |
| | $f = 1.0$ to 18GHz , $Z_o = 50\Omega$ | - | - | 5:1 | |

2. Mixer performance (I. F. = 45MHz)

| | | | | | |
|----------|--|---|-----|-------|----------|
| N_o | Measured overall noise figure | | | | |
| | $f = 9.375\text{GHz}$, $N_{if} = 1.5\text{dB}$ | | | | |
| | $P_{L.O.} = 200\mu\text{W}$, $I_{out} = 1.0\text{mA}$ | - | 9.0 | - | dB |
| | $f = 16.5\text{GHz}$, $N_{if} = 1.5\text{dB}$ | | | | |
| | $P_{L.O.} = 200\mu\text{A}$, $I_{out} = 1.0\text{mA}$ | - | 9.5 | - | dB |
| z_{if} | I. F. impedance | | | | |
| | $I_{out} = 1.0\text{mA}$ | - | 130 | - | Ω |
| | v.s.w.r. Voltage standing wave ratio | | | | |
| | $f = 1$ to 18GHz , $Z_o = 50\Omega$ | | | | |
| | $I_{out} = 1.0\text{mA}$ | - | - | 2.5:1 | |

3. Doppler mixer performance (I. F. = 3kHz)

| | | | | | |
|-------|---|---|----|---|----|
| N_o | Measured overall noise figure | | | | |
| | $f = 9.375\text{GHz}$, $N_{if} = 2.0\text{dB}$ | - | 18 | - | dB |

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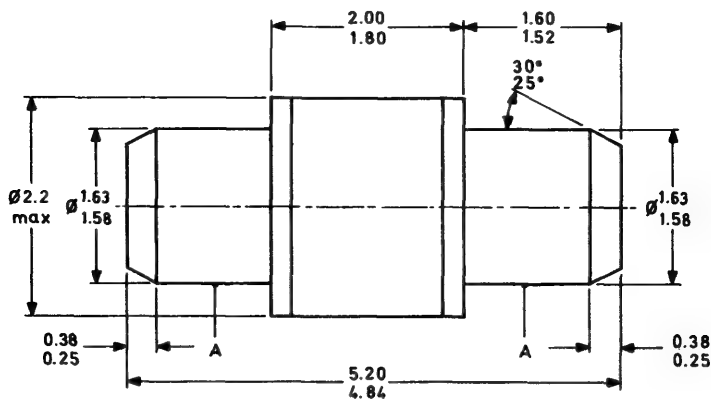
Sub-miniature germanium bonded backward diode primarily intended for broadband low level detector applications in K-band and in Q-band (Ka-band). It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

| | | |
|--|----------|---------------------------|
| Frequency range | 18 to 40 | GHz |
| Zero bias current sensitivity in the band 18 to 40 GHz (typ.) | 2.0 | $\mu\text{A}/\mu\text{W}$ |

OUTLINE AND DIMENSIONS

M.Q.M.



All dimensions in mm

A = concentricity tolerance = ± 0.15

D1654a

Terminal identification: red end indicates Cathode

POLARITY IDENTIFICATION

The positive end (cathode) is marked red and the negative end (anode) is marked blue. The positive end indicates the electrode which becomes positive in an a.c. rectifier circuit.

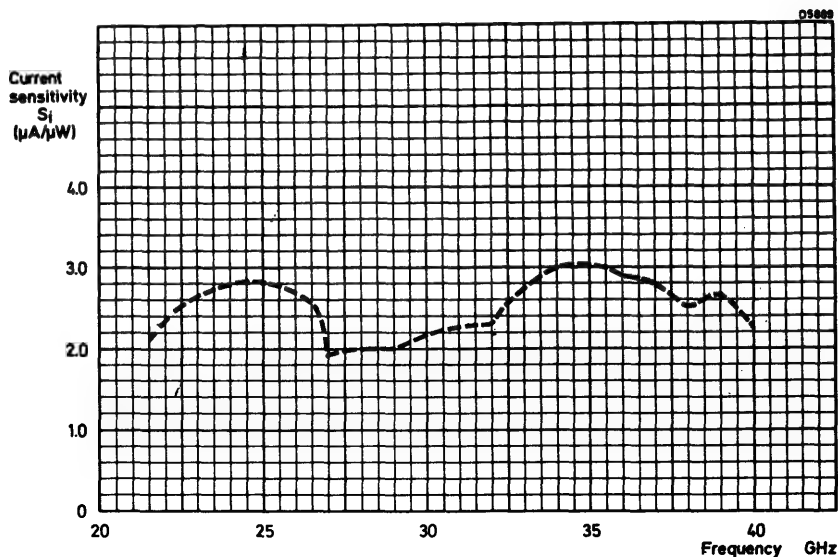
RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--|-------------|--------------------|
| Max. pulsed r.f. input power ($f = 9.375\text{GHz}$, $t_p = 0.5\mu\text{s}$, p. r. f. = 2000 p. p. s.) | 40 | mW |
| T_{amb} range | -55 to +100 | $^{\circ}\text{C}$ |
| T_{stg} range | -55 to +100 | $^{\circ}\text{C}$ |

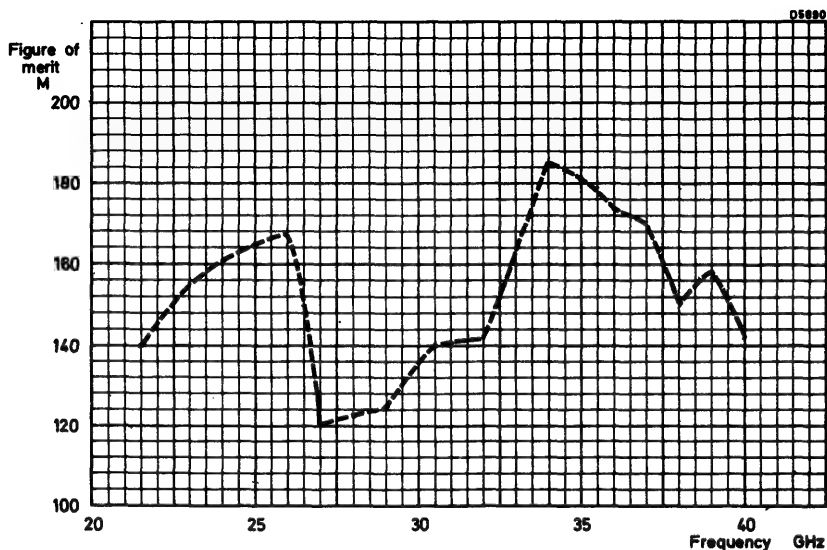
| ELECTRICAL CHARACTERISTICS | Min. | Typ. | Max. | |
|---|------|------|------|---------------------------|
| 1/f noise (see note 1) | - | - | 7.0 | dB |
| Swept v. s. w. r. (26.5 to 40GHz) (see note 2) | - | - | 5: 1 | |
| Z_v video impedance (see note 3) | 3.0 | - | 5.0 | k Ω |
| S_i current sensitivity (see note 4) | - | 2.0 | - | $\mu\text{A}/\mu\text{W}$ |
| M figure of merit (see note 5) | 50 | - | - | |

NOTES

1. Measured at an i. f. of 1kHz with 50Hz bandwidth and zero bias.
2. Measured in a Q-band broadband mount (Mullard specification 7313-731-0091). The v. s. w. r. measurement is swept over the band 26.5 to 40GHz at a power level not exceeding 100 μW and with zero bias.
3. Measured at an i. f. of 1.6kHz with an input not exceeding 1mV and with zero bias.
4. Measured in the same mount as described in note 2 at frequencies of 27GHz, 34GHz and 40GHz, with an input power not exceeding 1 μW and with zero bias. Rectified current measured by a microammeter of resistance less than 10 Ω .
5. Measured at frequencies of 27GHz, 34GHz and 40GHz. M is the product of current sensitivity expressed in $\mu\text{A}/\mu\text{W}$ and square root of the video impedance expressed in ohms.



Typical current sensitivity as a function of frequency

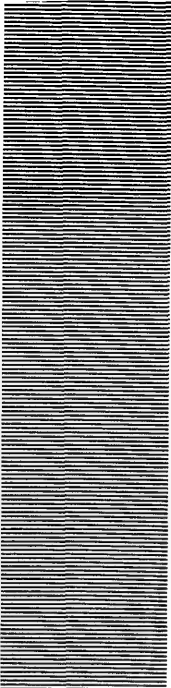


Typical figure of merit as a function of frequency

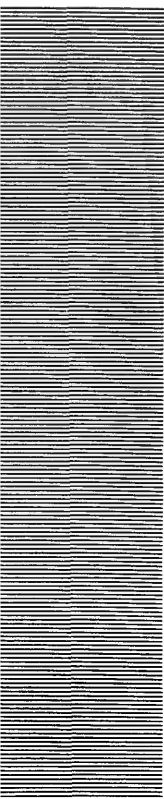
VARACTOR DIODES

**Multiplier
Special purpose
Tuning**

E



E



SILICON PLANAR EPITAXIAL VARACTOR DIODE

BAY96

Silicon planar epitaxial varactor diode for use as a high efficiency frequency multiplier in the v.h.f. and u.h.f. bands. As a tripler from 150 to 450 MHz it has a typical efficiency of 64% and can handle inputs up to 40 W. The BAY96 has a very low series resistance and is packaged in a low inductance, hermetically sealed, welded ceramic-metal envelope, DO-4 with stud cathode. It conforms to the environmental requirements of BS9300 where applicable.

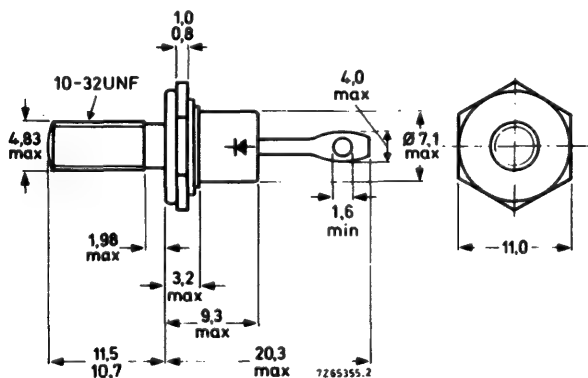
QUICK REFERENCE DATA

| | | |
|---|----------|----------|
| V_R max. | 120 | V |
| P_{tot} max. | 20 | W |
| T_j max. | 175 | °C |
| C_T ($V_R = 6.0$ V, $f = 1.0$ MHz) | 28 to 39 | pF |
| R_s max. ($V_R = 6.0$ V, $f = 400$ MHz) | 1.2 | Ω |
| $f_{co} = \frac{1}{2\pi R_s \cdot C_T}$ at $V_R = 120$ V typ. | 25 | GHz |

MECHANICAL DATA

Dimensions in mm ←

Conforming to J. E. D. E. C. DO-4



Diameter of clearance hole: max. 5.2 mm

Torque on nut: min. 0.9 Nm
max. 1.7 Nm

Accessories supplied on request:

56295 (PTFE bush, 2 mica washers, plain washer, tag)

56262A (mica washer, insulating ring, plain washer)

Supplied with device: 1 nut, 1 lock washer

Nut dimensions across the flats: 9.5 mm

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RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

| | | |
|--|-----|---|
| V_R max. | 120 | V |
| P_{tot} max. ($T_{mb} = 25\text{ }^{\circ}\text{C}$) | 20 | W |

Temperature

| | | |
|------------------------|-----|--------------------|
| T_{stg} min. | -65 | $^{\circ}\text{C}$ |
| T_{stg} max. | 175 | $^{\circ}\text{C}$ |
| T_j max. (operating) | 175 | $^{\circ}\text{C}$ |

THERMAL CHARACTERISTIC

| | | |
|----------------|-----|----------------------|
| $R_{th\ j-mb}$ | 7.5 | $^{\circ}\text{C/W}$ |
|----------------|-----|----------------------|

ELECTRICAL CHARACTERISTICS

| | | Min. | Typ. | Max. | |
|----------|--|------|------|------|----------|
| C_T | Total capacitance | | | | |
| | $V_R = 6.0\text{ V}, f = 1.0\text{ MHz}$ | 28 | - | 39 | pF |
| R_s | Series resistance | | | | |
| | $V_R = 6.0\text{ V}, f = 400\text{ MHz}$ | - | 0.9 | 1.2 | Ω |
| f_{co} | Cut-off frequency | | | | |
| | $V_R = 120\text{ V}$ | | | | |
| | $\frac{1}{2\pi R_s \cdot C_T}$ | - | 25 | - | GHz |

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BAY96

APPLICATION INFORMATION

TYPICAL OPERATING CHARACTERISTICS AS A FREQUENCY TRIPLER

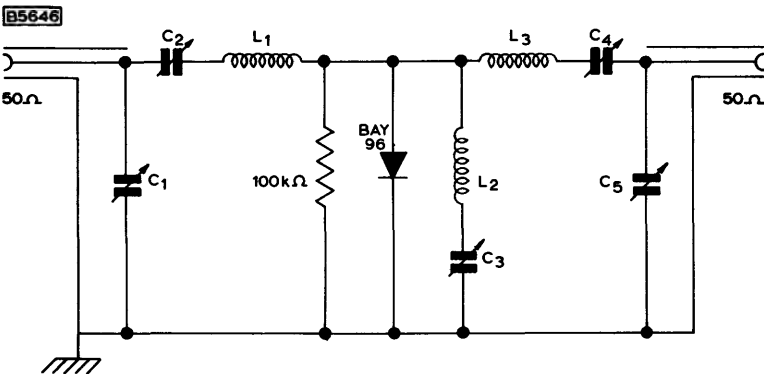


Fig.1

Frequency tripler circuit - 150 to 450 MHz

$L_1 = 6.5$ turns 18 s.w.g. wire 0.297" I.D. 0.562" long

$L_2 = 2$ turns 14 s.w.g. wire 0.266" I.D. 0.312" long

$L_3 = 1" \times 0.25" \times 0.020"$ copper strip 0.562" from chassis

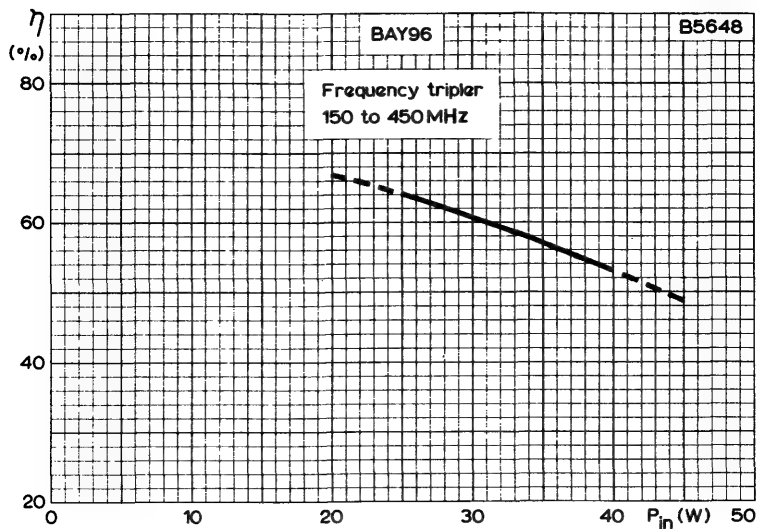
$C_1 = 7.0 - 100\text{pF}$ variable

$C_2, C_3, C_4 = 2.0 - 13\text{pF}$ variable

$C_5 = 2.0 - 25\text{pF}$ variable

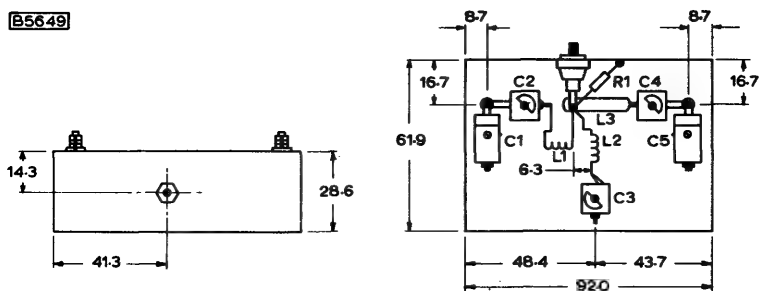
| | | Min. | Typ. | |
|--------|--|------|------|---|
| η | Efficiency | | | |
| | $P_{in} = 25\text{W}, f_{in} = 150\text{ MHz}$ | 60 | 64 | % |

APPLICATION INFORMATION (cont'd)



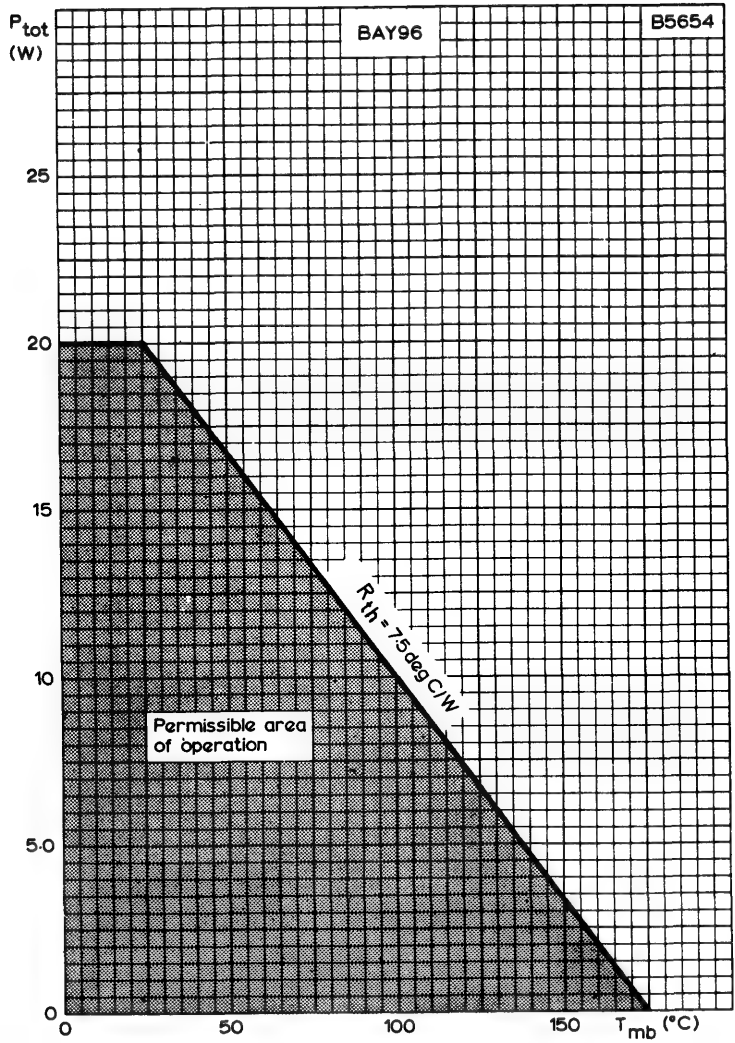
TYPICAL TRIPLER EFFICIENCY PLOTTED AGAINST INPUT POWER
See circuit on page 3

B5649

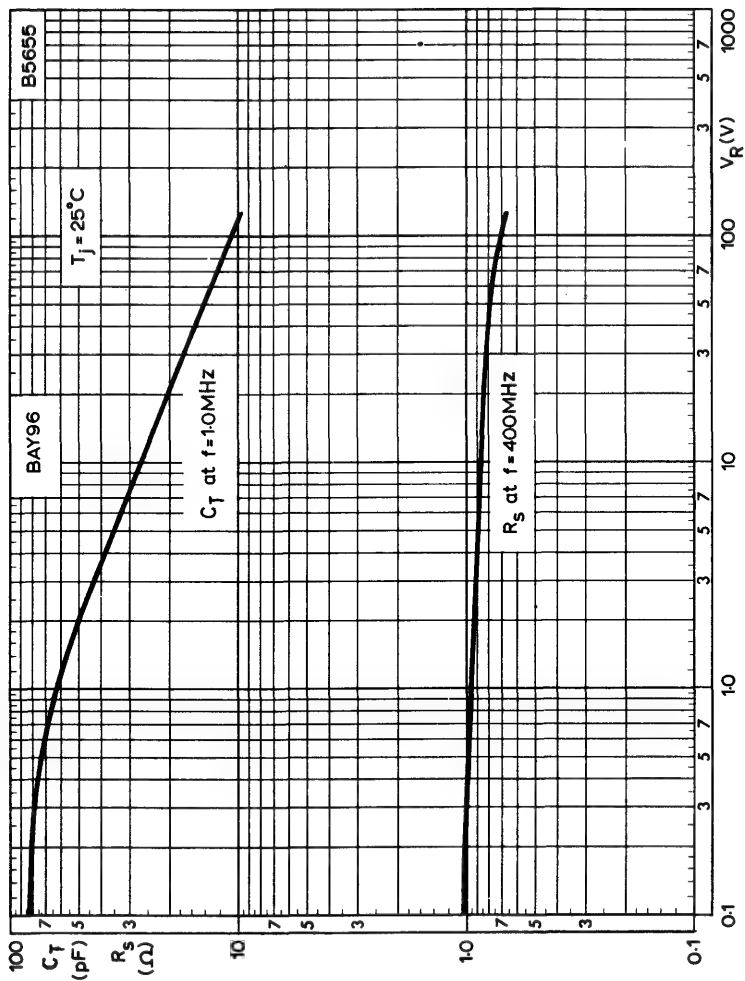


All dimensions in mm.

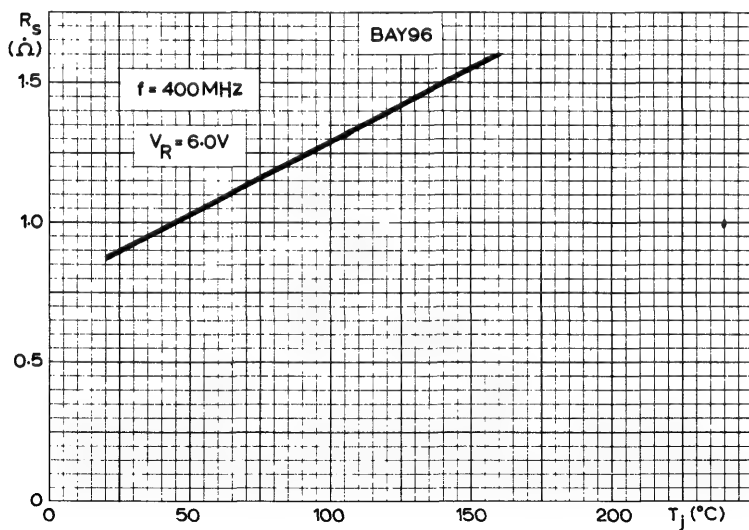
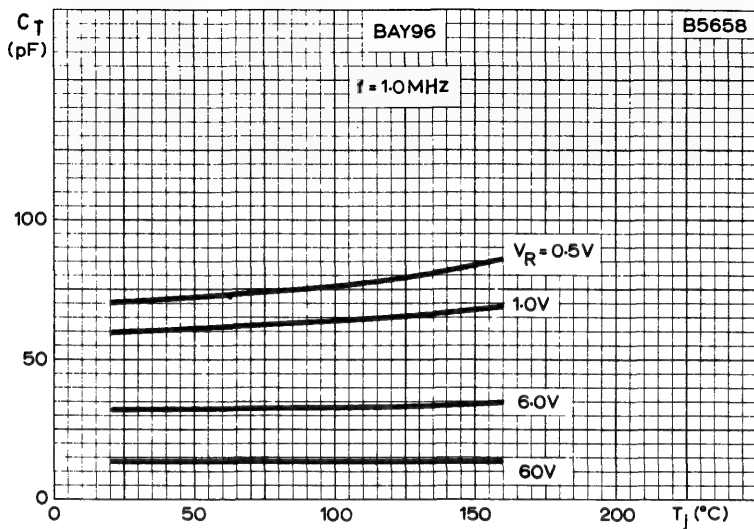
COMPONENT LAYOUT OF TRIPLER CIRCUIT



TOTAL DISSIPATION PLOTTED AGAINST MOUNTING BASE TEMPERATURE



TYPICAL DIODE CAPACITANCE AND SERIES RESISTANCE PLOTTED
AGAINST REVERSE VOLTAGE



TYPICAL DIODE CAPACITANCE AND SERIES RESISTANCE PLOTTED
AGAINST JUNCTION TEMPERATURE

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY27

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to 'S' band output frequency.

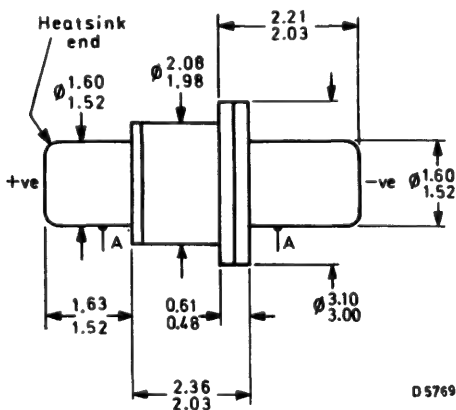
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency doubler 1 to 2 GHz in a typical circuit.

| | | |
|---|-----|-----|
| P_{in} | 10 | W |
| P_{out} | 5.0 | W |
| Resistive cut-off frequency typ. ($V_R = 6.0$ V) | 100 | GHz |
| Total capacitance typ. ($V_R = 6.0$ V) | 4.5 | pF |
| T_j max. | 150 | °C |

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|--|-----|---------|
| V_R max. | 55 | V |
| P_{tot} max. R.F., $T_{pin} \leq 70^\circ\text{C}$ | 4.0 | W |
| $T_{pin} > 70^\circ\text{C}$, derating factor | 50 | mW/degC |

Temperature

| | | |
|----------------|-----|------------------|
| T_{stg} min. | -55 | $^\circ\text{C}$ |
| T_{stg} max. | 150 | $^\circ\text{C}$ |
| T_j max. | 150 | $^\circ\text{C}$ |

THERMAL CHARACTERISTIC

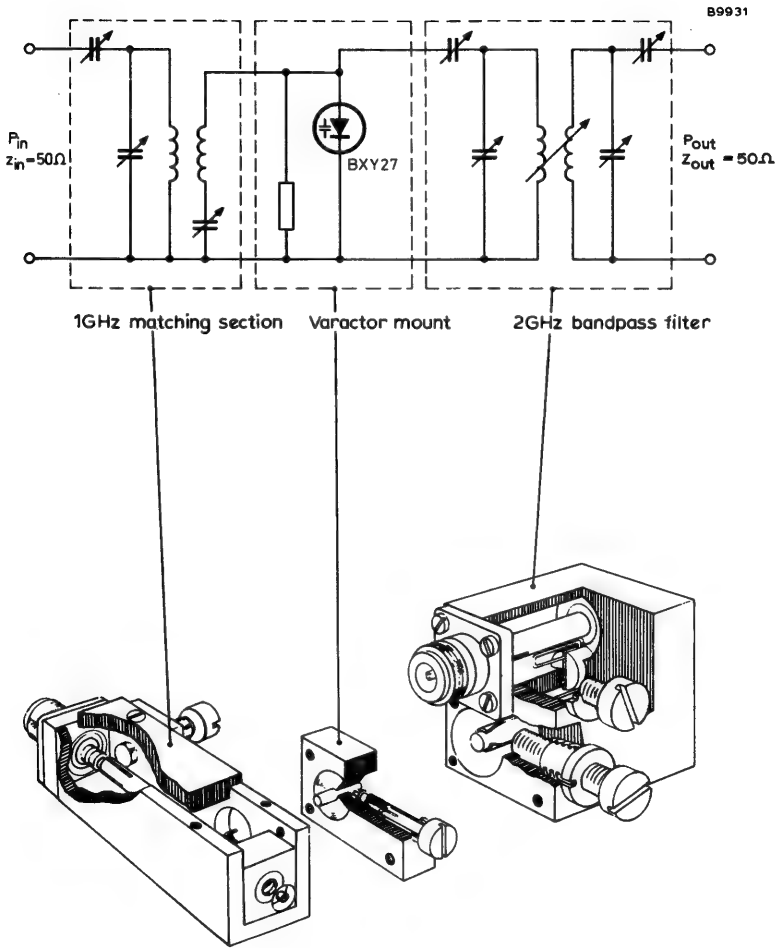
| | | |
|----------------------|----|--------|
| $R_{th\ j-pin}$ max. | 20 | degC/W |
|----------------------|----|--------|

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^\circ\text{C}$)

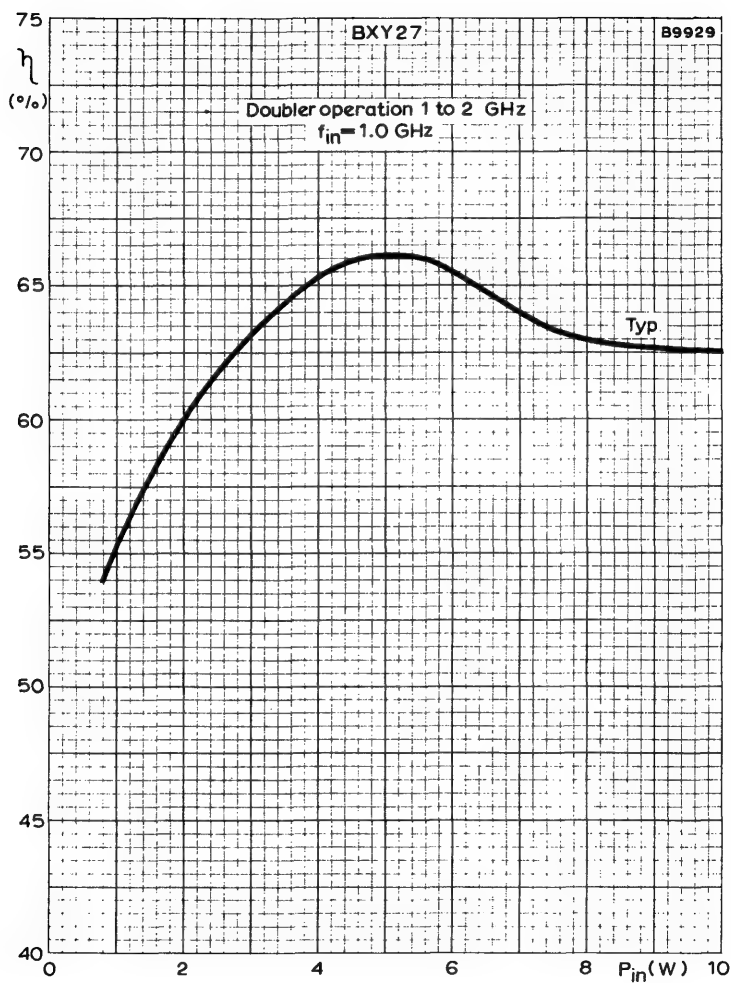
| | | Min. | Typ. | Max. | |
|-------------|--|------|-------|------|---------------|
| $V_{(BR)R}$ | Reverse breakdown voltage | 55 | 70 | - | V |
| I_R | Reverse current $V_R = 6.0\text{V}$ | - | 0.001 | 1.0 | μA |
| f_{co} | Cut-off frequency $\frac{1}{2\pi R_s C_j}$ $V_R = 6.0\text{V}$ | 50 | 100 | - | GHz |
| C_T | Total capacitance ($C_j + C_s$) $V_R = 6.0\text{V}$, $f = 1.0\text{MHz}$ | 3.0 | 4.5 | 6.0 | pF |
| C_s | Stray capacitance | - | 0.25 | - | pF |
| L_s | Series inductance | - | 650 | - | pH |
| r_s | Series resistance $V_R = 6.0\text{V}$ | - | 0.4 | - | Ω |
| η | Overall efficiency $P_{in} = 10\text{W}$, $f_{in} = 1.0\text{GHz}$ | | | | |
| | frequency doubler | 50 | 60 | - | % |
| | frequency trebler | - | 40 | - | % |

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY27



APPLICATION INFORMATION
FREQUENCY DOUBLER CIRCUIT (1 to 2GHz)



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
 FOR DOUBLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY28

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to C-band output frequency.

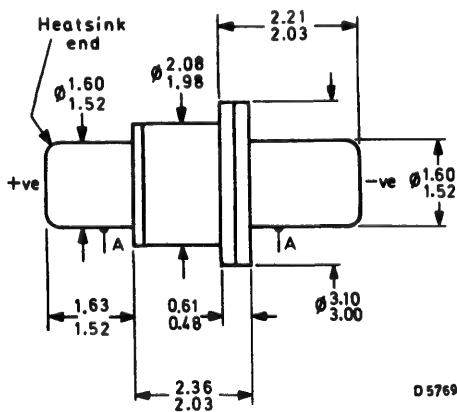
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency doubler 2 to 4 GHz in a typical circuit.

| | | |
|---|-----|-----|
| P_{in} | 7.0 | W |
| P_{out} | 3.5 | W |
| Resistive cut-off frequency typ. ($V_R = 6.0$ V) | 120 | GHz |
| Total capacitance typ. ($V_R = 6.0$ V) | 1.5 | pF |
| T_j max. | 150 | °C |

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|--|-----|---------|
| V_R max. | 45 | V |
| P_{tot} max. R.F., $T_{pin} \leq 70^\circ\text{C}$ | 2.7 | W |
| $T_{pin} > 70^\circ\text{C}$; derating factor | 34 | mW/degC |

Temperature

| | | |
|----------------|-----|------------------|
| T_{stg} min. | -55 | $^\circ\text{C}$ |
| T_{stg} max. | 150 | $^\circ\text{C}$ |
| T_j max. | 150 | $^\circ\text{C}$ |

THERMAL CHARACTERISTIC

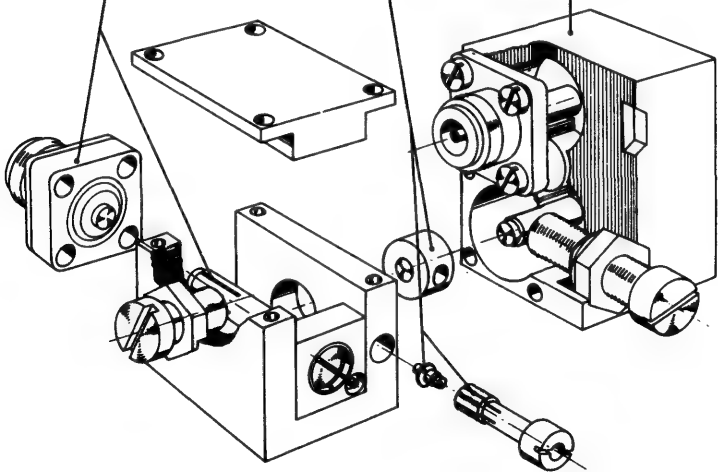
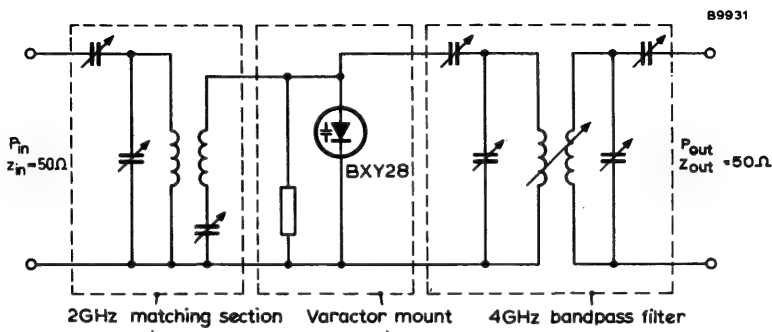
| | | |
|----------------------|----|--------|
| $R_{th\ j-pin}$ max. | 30 | degC/W |
|----------------------|----|--------|

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^\circ\text{C}$)

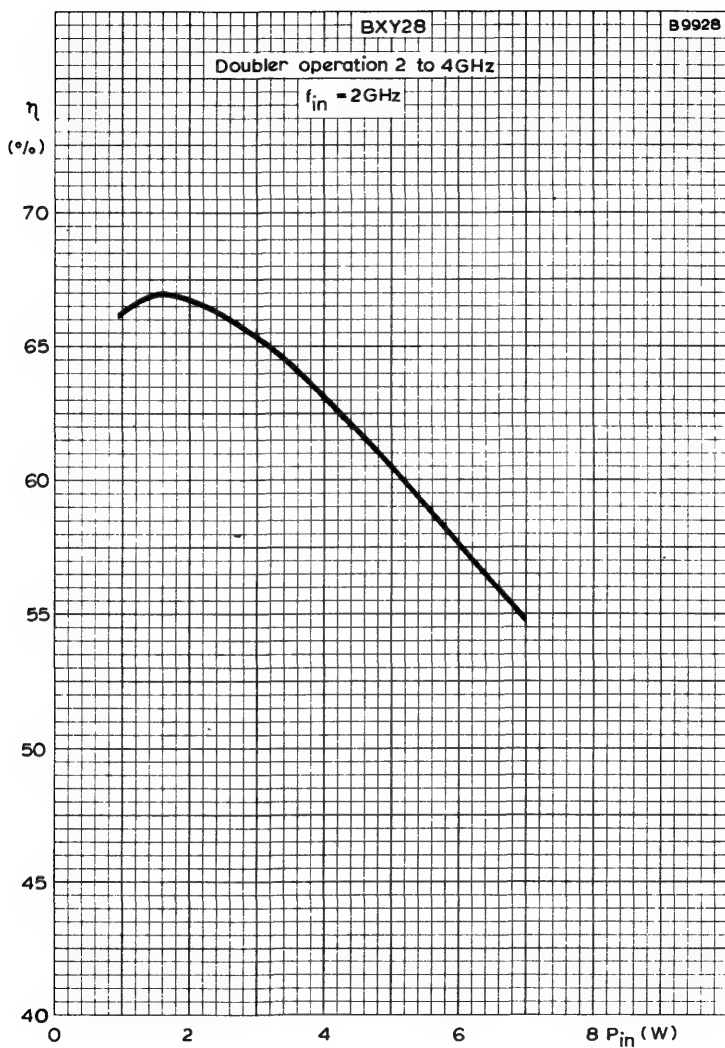
| | | Min. | Typ. | Max. | |
|-------------|--|------|-------|------|---------------|
| $V_{(BR)R}$ | Reverse breakdown voltage | 45 | 60 | - | V |
| I_R | Reverse current $V_R = 6.0\text{V}$ | - | 0.001 | 1.0 | μA |
| f_{co} | Cut-off frequency $\frac{1}{2\pi r_s C_j}$ $V_R = 6.0\text{V}$ | 80 | 120 | - | GHz |
| C_T | Total capacitance ($C_j + C_s$) $V_R = 6.0\text{V}$, $f = 1.0\text{MHz}$ | 1.0 | 1.5 | 2.5 | pF |
| C_s | Stray capacitance | - | 0.25 | - | pF |
| L_s | Series inductance | - | 650 | - | pH |
| r_s | Series resistance $V_R = 6.0\text{V}$ | - | 1.0 | - | Ω |
| η | Overall efficiency $P_{in} = 7.0\text{W}$, $f_{in} = 2.0\text{GHz}$ frequency doubler | 50 | - | - | % |

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY28



APPLICATION INFORMATION
FREQUENCY DOUBLER CIRCUIT (2 to 4GHz)



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR DOUBLER OPERATION

SILICON PLANAR EPITAXIAL VARACTOR DIODE

BXY29

Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for high order frequency multiplier circuits up to X-band output frequency.

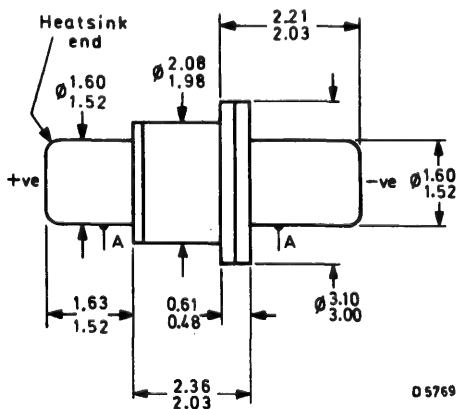
It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency quadrupler 2.25 GHz to 9.0 GHz in a typical circuit :-

| | | |
|---|-----|--------------------|
| P_{in} | 1.0 | W |
| P_{out} | 0.3 | W |
| Resistive cut-off frequency typ. ($V_R = 6.0$ V) | 120 | GHz |
| Total capacitance typ. ($V_R = 6.0$ V) | 1.0 | pF |
| T_j max. | 150 | $^{\circ}\text{C}$ |

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|--|-----|---|
| V_R max. | 25 | V |
| P_{tot} max. R. F. ($T_{pin} \leq 70^\circ C$) | 2.0 | W |

Temperature

| | | |
|----------------|------|------------|
| T_{stg} min. | -55 | $^\circ C$ |
| T_{stg} max. | +150 | $^\circ C$ |
| T_j max. | +150 | $^\circ C$ |

THERMAL CHARACTERISTIC

| | | |
|---------------------|----|--------|
| $R_{th j-pin}$ max. | 40 | degC/W |
|---------------------|----|--------|

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^\circ C$)

| | | Min. | Typ. | Max. | |
|-------------|--|------|-------|------|---------|
| $V_{(BR)R}$ | Reverse breakdown voltage ($I_R = 1.0mA$) | 25 | - | - | V |
| I_R | Reverse current ($V_R = 6.0V$) | - | 0.001 | 1.0 | μA |
| f_{co} | Cut-off frequency ($V_R = 6.0V$) (see note) | 90 | 120 | - | GHz |
| C_T | Total capacitance ($C_j + C_s$) ($V_R = 6.0V$, $f = 1.0MHz$) | 0.8 | 1.0 | 1.5 | pF |
| C_s | Stray capacitance | - | 0.25 | - | pF |
| L_s | Series inductance | - | 650 | - | pH |
| η | Overall efficiency $P_{in} = 1.0W$, $f_{in} = 2.25GHz$ frequency quadrupler | 30 | - | - | % |

Note. The cut-off frequency f_{co} is defined as:

$$f_{co} = \frac{1}{2\pi r_s C_j}$$

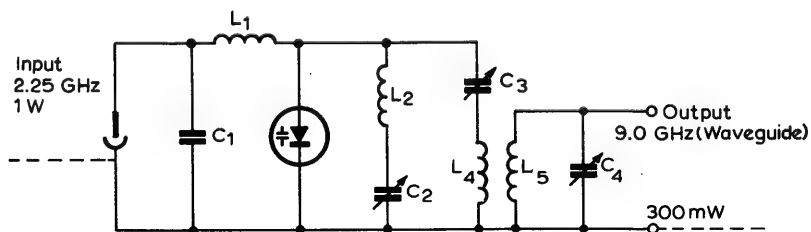
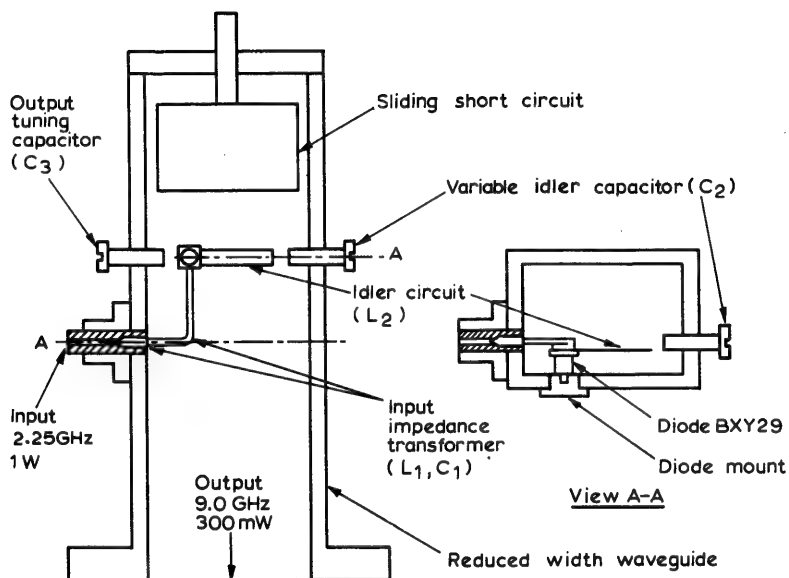
Where, C_j is the junction capacitance and is measured at 1.0MHz
 r_s is measured on a slotted line at 2.0GHz.

SILICON PLANAR EPITAXIAL VARACTOR DIODE

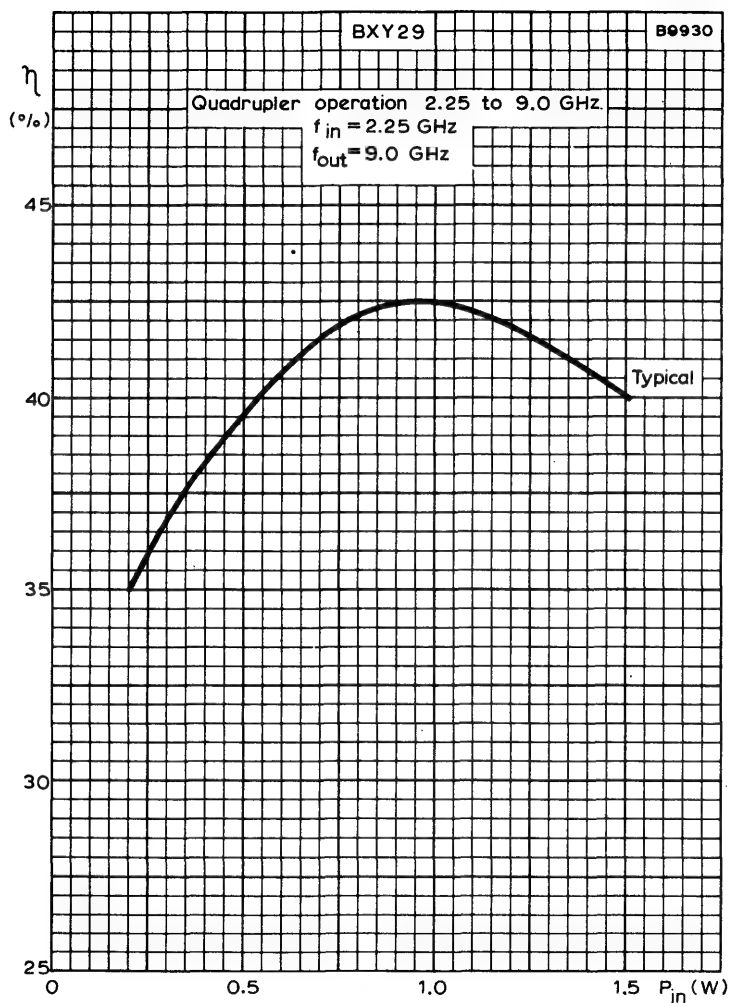
BXY29

S-X BAND QUADRUPLER

B9937



Approximate equivalent circuit



OVERALL EFFICIENCY PLOTTED AGAINST INPUT POWER
FOR QUADRUPLER OPERATION

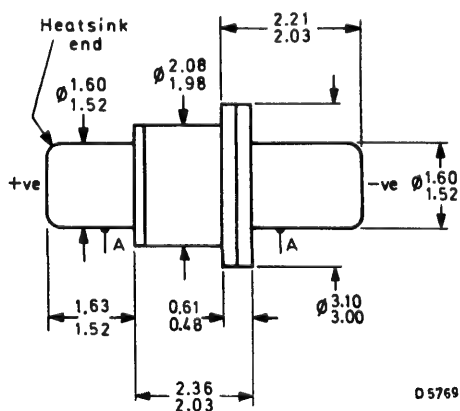
BXY32

It is a diffused silicon device and is mounted in a small double-ended ceramic-metal case with hermetic seal and conforms to the environmental requirements of BS9300 where applicable.

Operation as a high order frequency multiplier 1.0 GHz to 10 GHz in a typical circuit :-

| | | |
|---|------|-----|
| P_{in} | 500 | mW |
| P_{out} | 20 | mW |
| Resistive cut-off frequency typ. ($V_R = 6.0$ V) | 150 | GHz |
| Total capacitance typ. ($V_R = 6.0$ V) | 0.75 | pF |
| T_i max. | 150 | °C |

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|---|-----|---|
| V_R max. | 20 | V |
| P_{tot} max. R.F. ($T_{pin} \leq 70^\circ\text{C}$) | 1.6 | W |

Temperature

| | | |
|----------------|------|------------------|
| T_{stg} min. | -55 | $^\circ\text{C}$ |
| T_{stg} max. | +150 | $^\circ\text{C}$ |
| T_j max. | +150 | $^\circ\text{C}$ |

THERMAL CHARACTERISTIC

| | | |
|----------------------|----|--------|
| $R_{th\ j-pin}$ max. | 50 | degC/W |
|----------------------|----|--------|

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^\circ\text{C}$)

| | | Min. | Typ. | Max. | |
|-------------|--|------|-------|------|---------------|
| $V_{(BR)R}$ | Reverse breakdown voltage ($I_R = 1.0\text{mA}$) | 20 | - | - | V |
| I_R | Reverse current ($V_R = 6.0\text{V}$) | - | 0.001 | 1.0 | μA |
| f_{co} | Cut-off frequency ($V_R = 6.0\text{V}$) (see note) | 100 | 150 | - | GHz |
| C_T | Total capacitance ($C_j + C_s$) ($V_R = 6.0\text{V}$, $f = 1.0\text{MHz}$) | 0.5 | 0.75 | 1.0 | pF |
| C_s | Stray capacitance | - | 0.25 | - | pF |
| L_s | Series inductance | - | 650 | - | pH |
| t_t | Transition time | - | - | 150 | ps |
| τ_s | Life time | - | 50 | - | ns |

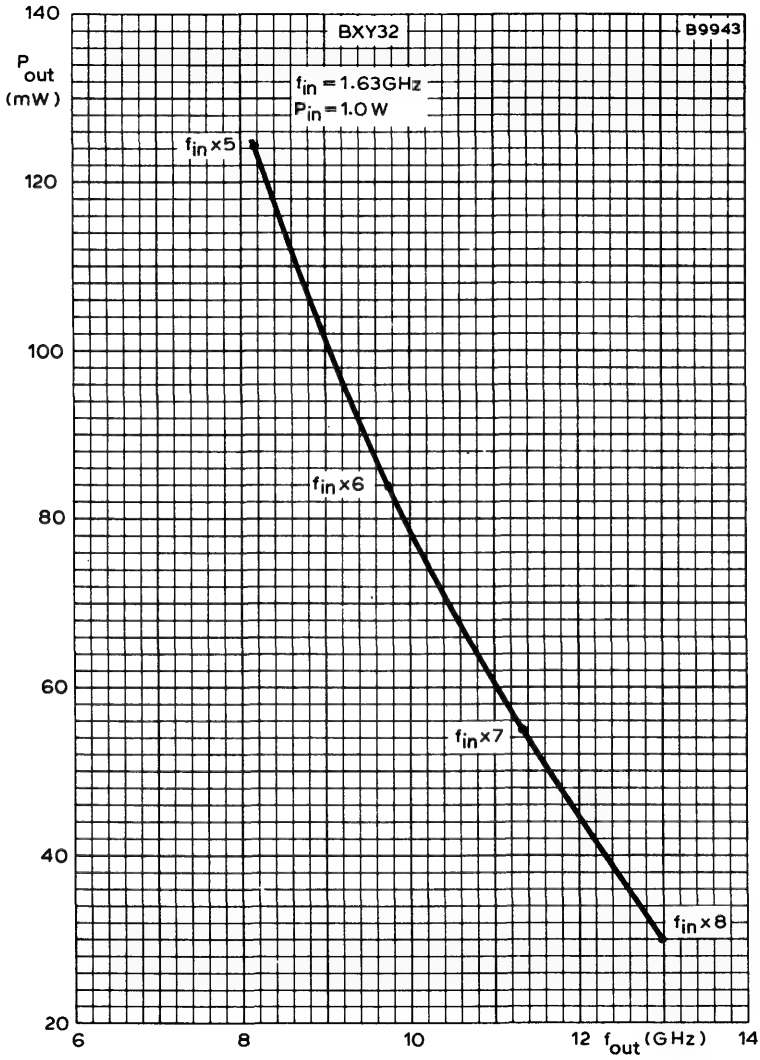
Note. The cut-off frequency f_{co} is defined as:

$$f_{co} = \frac{1}{2\pi r_s C_j}$$

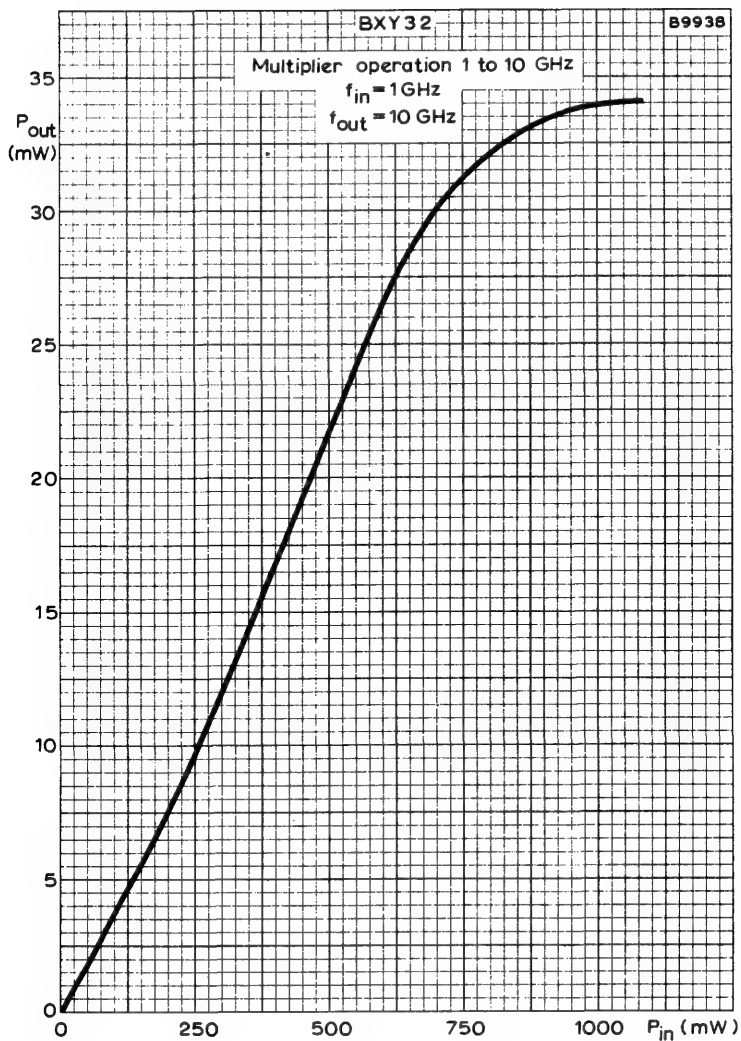
Where, C_j is the junction capacitance and is measured at 1.0MHz
 r_s is measured on a slotted line at 8.0GHz

MULTIPLIER PERFORMANCE

| | | Min. | Typ. | Max. | |
|-----------|--|------|------|------|----|
| P_{out} | $f_{in} = 1.0\text{GHz}$, $P_{in} = 500\text{mW}$, $f_{out} = 10\text{GHz}$ | 15 | 20 | - | mW |



TYPICAL PERFORMANCE IN HIGH ORDER
MULTIPLIERS



TYPICAL PERFORMANCE AS A FREQUENCY
MULTIPLIER

SILICON VARACTOR DIODES

Silicon planar varactor diodes exhibiting step recovery characteristics, especially suitable for use in frequency multipliers. They conform to the environmental requirements of BS9300 where applicable.

| | | | BXY35 | BXY36 | BXY37 | BXY38 | BXY39 | BXY40 | BXY41 | |
|---|----------------|------|-------|-------|-------|-------|-------|-------|-------|---------------|
| Reverse breakdown voltage $I_R = 10 \mu A$ | $V_{(BR)R}$ | min. | 100 | 70 | 70 | 50 | 40 | 25 | 25 | V |
| Cut-off frequency $V_R = 6 V$ | f_{co} | min. | 25 | 75 | 100 | 120 | 150 | 180 | 200 | GHz |
| Diode capacitance $V_R = 6 V$ | C_j | min. | 6.0 | 4.0 | 2.0 | 1.2 | 0.8 | 0.4 | 0.25 | pF |
| | | max. | 12 | 6.0 | 4.0 | 2.0 | 1.2 | 0.9 | 0.5 | pF |
| Transition time | t_{tr} | max. | — | 500 | 350 | 300 | 200 | 150 | 100 | ps |
| Storage time | t_s | typ. | — | 150 | 100 | 75 | 50 | 50 | 25 | ns |
| Thermal resistance junction to mounting base, types A,D,E | $R_{th j-mb}$ | | 10 | 20 | 20 | 30 | 40 | 50 | 50 | $^{\circ}C/W$ |
| Thermal resistance junction to pin, types B and C | $R_{th j-pin}$ | | 10 | 20 | 20 | 30 | 40 | 50 | 50 | $^{\circ}C/W$ |
| Multiplier performance | | | | | | | | | | |
| Typical output frequency range | | min. | 0.75 | 2 | 4 | 6 | 7 | 8 | 10 | GHz |
| | | max. | 2 | 4 | 6 | 8 | 9 | 10 | 14 | GHz |
| Outlines available | | A | — | — | — | — | — | — | — | |
| | | — | B | B | B | B | B | B | B | |
| | | — | C | C | C | C | C | C | C | |
| | | — | D | D | D | D | D | D | D | |
| | | — | E | E | E | E | E | E | E | |

Devices may be selected to suit
customers' specific requirements

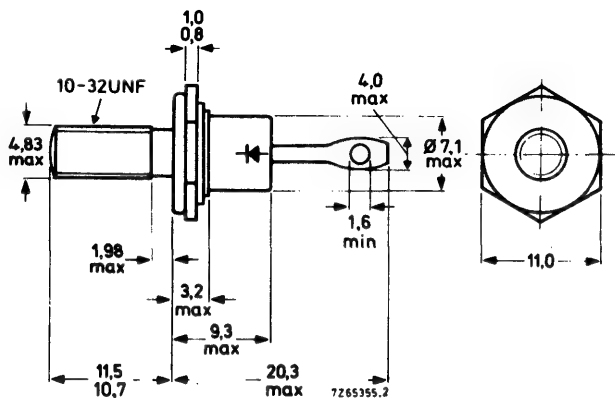


MECHANICAL DATA

Dimensions in mm

Outline A

DO-4



Diameter of clearance hole: 5.2 mm

Torque on nut: min. 0.9 Nm
max. 1.7 Nm

Accessories supplied on request:

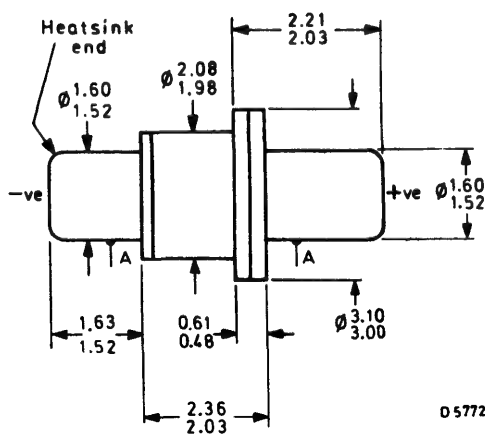
56295 (PTFE bush, 2 mica washers, plain washer, tag)

56262A (mica washer, insulating ring, plain washer)

Supplied with device: 1 nut, 1 lock washer

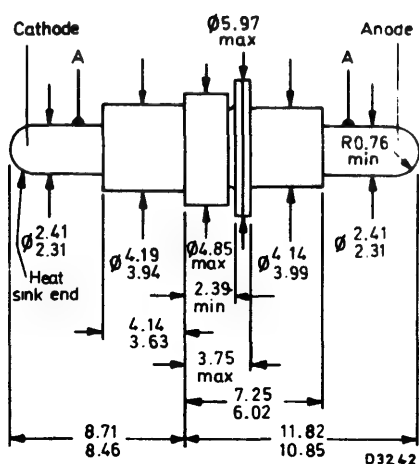
Nut dimensions across the flats: 9.5 mm

Outline B

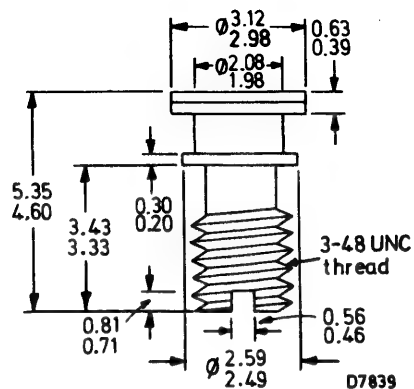


A = concentricity tolerance = ± 0.13

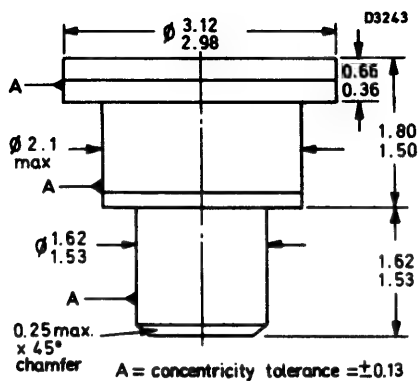
Outline C



Outline D



Outline E



SILICON VARACTOR TUNING DIODES

BXY53
BXY54
BXY55

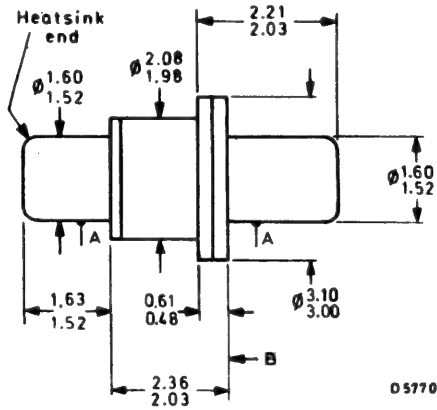
Epitaxial silicon varactor tuning diodes supplied in a standard microwave package. ←
They conform to the environmental requirements of BS9300 where applicable.

| QUICK REFERENCE DATA | | | | |
|--------------------------------|-------|-------------|-------|----|
| V_R max. | BXY53 | 60 BXY54 | BXY55 | V |
| C_T at -4V typ. | 1.0 | 4.7 | 15 | pF |
| $\frac{C_{T0}}{C_{T60V}}$ min. | 4.0 | 6.5 | 7.0 | pF |

Unless otherwise shown, data is applicable to all types

OUTLINE AND DIMENSIONS

Conforms to B. S. 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm



Normal operation with reverse bias, i.e. heatsink end positive.

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | | |
|-----------------|-------------------|-------------|--------------------|
| V_R | max. (see note 1) | 60 | V |
| T_{stg} range | | -55 to +175 | $^{\circ}\text{C}$ |
| T_{case} | max. | 125 | $^{\circ}\text{C}$ |

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25^{\circ}\text{C}$)

| | | BXY53 | BXY54 | BXY55 | |
|-------------------------------------|------|-------|-------|-------|---------------|
| $V_{(BR)R}$ (10 μA min.) | | 60 | 60 | 60 | V |
| I_R at 55V | max. | 1.0 | 1.0 | 1.0 | μA |
| C_T at -4V | min. | 0.8 | 3.7 | 12 | pF |
| (see note 2) | typ. | 1.0 | 4.7 | 15 | pF |
| | max. | 1.2 | 5.7 | 18 | pF |

Total capacitance ratio

| | | | | | |
|---------------------------|------|-----|-----|-----|--|
| $\frac{C_{TO}}{C_{T60V}}$ | min. | 4.0 | 6.5 | 7.0 | |
|---------------------------|------|-----|-----|-----|--|

Insertion loss (zero bias)

| | | | | | |
|------------------------|------|-----|-----|------|----|
| (see notes 3, 4 and 5) | max. | 0.8 | 0.5 | 0.25 | dB |
|------------------------|------|-----|-----|------|----|

| | | | | | |
|-------------|------|----|----|----|---------|
| Phase swing | min. | 80 | 85 | 63 | degrees |
|-------------|------|----|----|----|---------|

| | | | | | |
|------------|------|----|----|----|---------|
| (0 to 60V) | typ. | 72 | 74 | 57 | degrees |
|------------|------|----|----|----|---------|

(see notes
3, 4 and 5)

NOTES

1. At 25°C ; below 25°C this figure must be derated at $7 \times 10^{-2} \text{V}/^{\circ}\text{C}$. Diodes with different values of $V_{(BR)R}$ are available on request.
2. Capacitance tolerances of $\pm 10\%$ and lower are available on request.
3. Measurements made with the diode at the end of a 50 Ω transmission line and with small signal conditions.
4. Measured at 2.0GHz for BXY53 and BXY54; at 1.0GHz for BXY55. For values at other frequencies see graphs on page 4.
5. The heatsink pin should be located in a hole of 1.6 to 1.65mm dia. The location of the other end should be a hole of 1.8 to 2.2mm dia., bearing on flange B with a force not exceeding 10 N.

APPLICATION NOTE

When designing tuning circuits at high frequencies it is not sufficient to specify a capacitance swing and loss resistance in the tuning varactor. The parasitic reactances of the microwave package have a significant effect on the terminal impedance of the device. Although strictly speaking one must consider the entire circuit when quoting impedance values the method of measurement adopted here has been found to give values of useful accuracy in a variety of coaxial and waveguide test mounts.

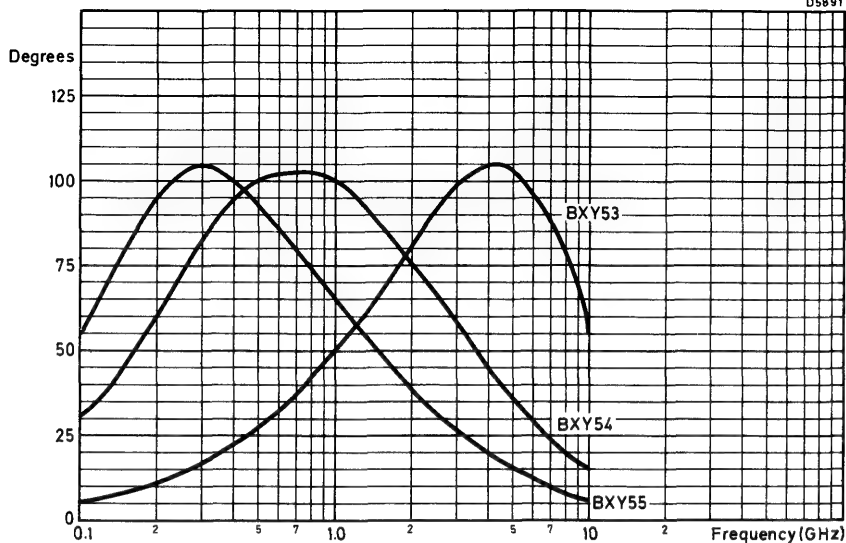
APPLICATION NOTE (contd.)

One may simply take the measurements as giving values of r.f. impedance as a function of bias for small signal conditions or they can be used as a more fundamental design aid. This is because the significant factors for the design of a micro-wave varactor tuned circuit are the available phase swing in the circuit and the loss incurred by the varactor. Both these quantities can be increased or decreased by lowering or raising respectively the characteristic impedance of the circuit. Both these quantities are also invariant under transformation down a uniform lossless transmission line and apply whatever impedance is required to be presented by the varactor circuit.

At large signal levels the r.f. swing may drive the varactor into forward conduction for part of the cycle. This has two effects, firstly there is a rectified voltage built up on the varactor terminal and secondly the effective insertion loss rises at low bias voltages. These effects are fundamental to any varactor diode.

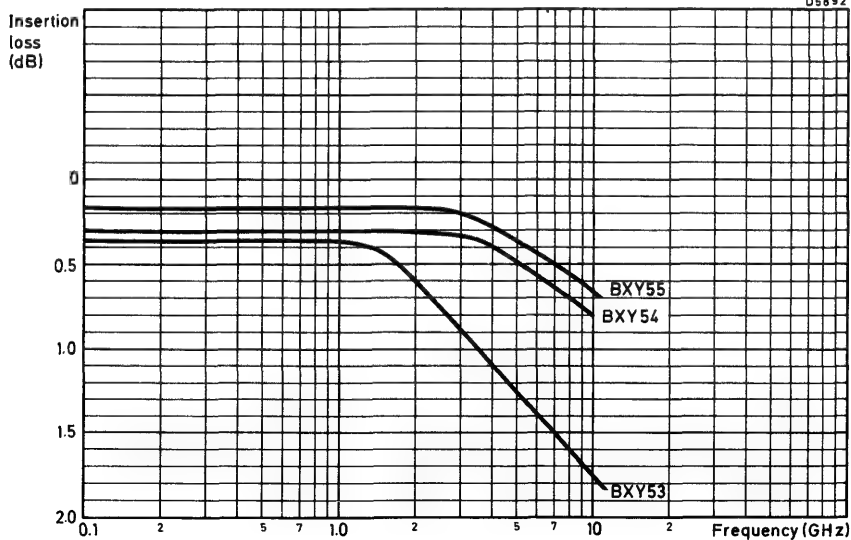
Under forward d.c. bias conditions, the maximum bias current must not exceed 100mA or permanent damage may occur.

D5891



TYPICAL PHASE SWING AS A FUNCTION
OF FREQUENCY

D5892



TYPICAL INSERTION LOSS AS A
FUNCTION OF FREQUENCY

SILICON VARACTOR DIODES

BXY56 BXY57

High efficiency silicon varactor diodes suitable for operation in low and high order multiplier circuits with output frequencies in the range 3 to 8 GHz. These diodes are of the diffused epitaxial type, having mesa construction for optimum performance and conform to the environmental requirements of BS9300 where applicable.

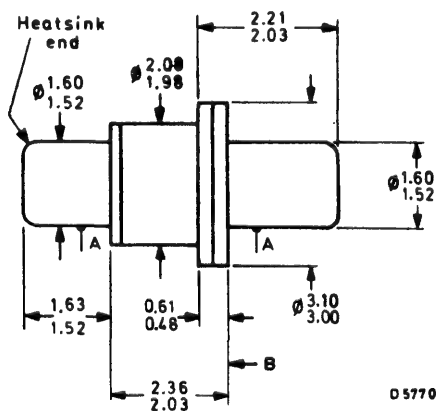
QUICK REFERENCE DATA

| | | | |
|---|-------|-------|-----|
| $V_{BR(R)}$ min. ($I_R = 10 \mu A$ min.) | | 60 | V |
| | BXY56 | BXY57 | |
| C_j ($V_R = 6 V$) min. | 1.5 | 2.5 | pF |
| max. | 2.5 | 3.5 | pF |
| f_c ($V_R = 6 V$ min.) | 160 | 140 | GHz |

Unless otherwise shown, data is applicable to both types

OUTLINE AND DIMENSIONS

Conforms to BS3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm



Normal operation with reverse bias, i.e. heatsink end positive.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | BXY56 | BXY57 | |
|---|-------------|-------------|------|
| V_R max. | 60 | 60 | V |
| P_{tot} max. (T_{hs} max. 50°C) (see note 1) | 5.2 | 6.6 | W |
| R_{th} (j-hs) max. | 24 | 19 | °C/W |
| T_{stg} range | -55 to +175 | -55 to +175 | °C |
| T_j max. | +175 | +175 | °C |

CHARACTERISTICS ($T_{pin} = 25^{\circ}\text{C}$)

| | | | |
|---|------|------|-----|
| $V_{(BR)R}$ min. ($I_R = 10\mu\text{A}$) | 60 | 60 | V |
| C_j ($V_R = 6\text{V}$, $f = 1\text{MHz}$) (see note 2) | | | |
| min. | 1.5 | 2.5 | pF |
| max. | 2.5 | 3.5 | pF |
| f_{co} min. ($V_R = 6\text{V}$) (see note 3) | 160 | 140 | GHz |
| t_t typ. (transition time) | 150 | 200 | ps |
| τ typ. (lifetime) | 60 | 150 | ns |
| C_s typ. | 0.25 | 0.25 | pF |
| L_s typ. | 650 | 650 | pH |

MULTIPLIER PERFORMANCE (see note 4)

| | | |
|--|----|---|
| Low order multiplier efficiency in a 2.1 to 4.2GHz doubler | 60 | % |
| High order multiplier efficiency in a 0.45 to 3.6GHz 8 × multiplier | 20 | % |

NOTES

- $P_{tot} = P_{in} - P_{out}$. Derating curves are used for value of T_{hs} greater than 50°C: -

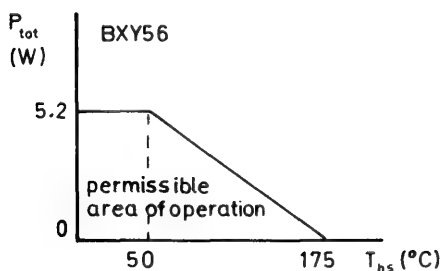


Fig. 1

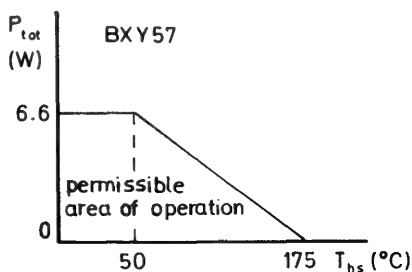


Fig. 2

NOTES (contd.)

2. A particular diode specification within this range may be selected to suit the application. Furthermore, it is recommended that devices are functionally tested by the supplier in the customer's circuit.

3. Cut-off frequency is measured using a slotted line system at 2GHz. $f_{co} = \frac{1}{2\pi R_s C_j}$

4. For high power applications it is essential that the heatsink end of the devices is gripped by a collet or equivalent clamping system to ensure the best possible thermal conductivity, this in turn should be coupled to an adequate heatsink. Care must be taken to avoid unnecessary deformation of this diode pin, as this may cause cracking of the metal-ceramic hermetic seal.

The location of the top cap should be a hole of diameter 1.8 to 2.2mm. bearing on flange B with a force not exceeding 10 N.

**GALLIUM ARSENIDE
VARACTOR DIODE**

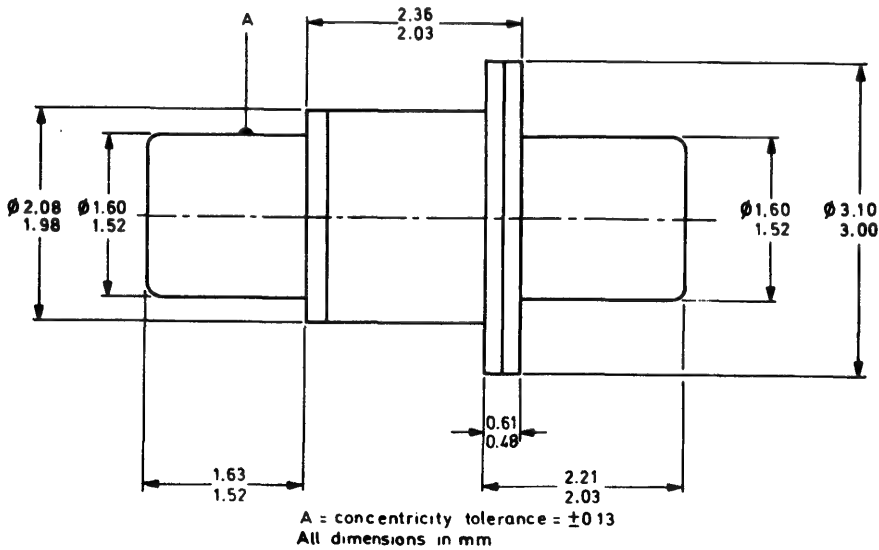
CAY10

Gallium arsenide varactor diode with a high cut-off frequency for use in parametric amplifiers, frequency multipliers and switches. The diodes are of the diffused mesa type, are mounted in a small ceramic-metal case with a welded hermetic seal and conform to the environmental requirements of BS9300 where applicable.

| QUICK REFERENCE DATA | | |
|--|--------------|-----|
| V_R max. | 6.0 | V |
| $I_F(AV)$ max. | 70 | mA |
| P_{tot} max. T_{stud} up to 107 °C | 50 | mW |
| for higher temperatures see derating curve | | |
| Operating temperature range | -196 to +150 | °C |
| f_c typ. ($V_R = 6.0$ V) | 240 | GHz |

OUTLINE AND DIMENSIONS

Conforms to B.S. 3934 SO86



05476

Limiting values of operation according to the absolute maximum system.

Electrical

| | | |
|--|-----|----|
| V_R max. | 6.0 | V |
| $I_{F(AV)}$ max. | 70 | mA |
| P_{tot} max. ($T_{stud} \leq 107^\circ\text{C}$) | 50 | mW |

Temperature

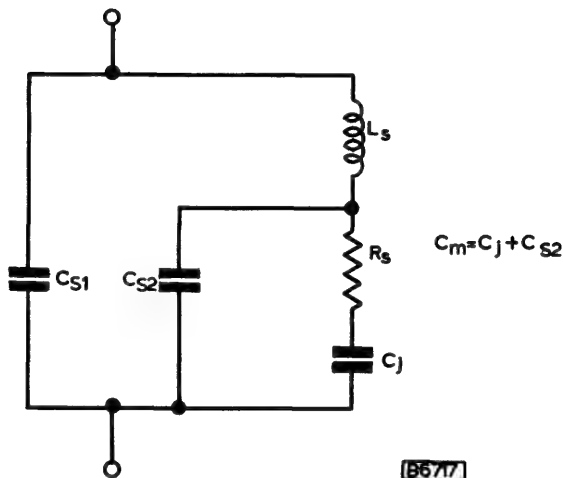
| | | |
|-------------------------|--------------|------------------|
| T_{stg} min. | -196 | $^\circ\text{C}$ |
| T_{stg} max. | +150 | $^\circ\text{C}$ |
| T_j (operating range) | -196 to +150 | $^\circ\text{C}$ |

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^\circ\text{C}$)

| | | Min. | Typ. | Max. | |
|----------------|---|------|------|------|---------------|
| Static | | | | | |
| I_R | Reverse current $V_R = 6.0\text{V}$ | - | 0.1 | 1.0 | μA |
| V_F | Forward voltage drop $I_F = 1.0\mu\text{A}$ (see note 3.) | - | 0.9 | - | V |
| Dynamic | | | | | |
| f_o | Series resonant frequency Zero bias (see notes 1, 2.) | 8.9 | 10 | 11.6 | GHz |
| f_{co} | Cut-off frequency Zero bias (see note 2.) | 125 | 150 | - | GHz |
| f_c | Cut-off frequency $V_R = 6.0\text{V}$ (see note 2.) | - | 240 | - | GHz |
| C_{mo} | Effective diode capacitance at X band frequency Zero bias (see notes 1, 2.) | 0.3 | 0.4 | 0.5 | pF |
| γ | Capacitance variation coefficient (see note 3.) | 0.12 | 0.15 | - | |
| C_{S1} | Stray capacitance (see note 1.) | - | 0.10 | - | pF |
| C_{S2} | Stray capacitance (see note 1.) | - | 0.15 | - | pF |
| L_s | Series inductance (see note 1.) | - | 625 | - | pH |

Notes

1. A suitable lumped circuit equivalent for the device may be drawn as follows:



2. Measurements at and about the series resonant frequency, in a suitable waveguide holder, enable the values of f_o and the diode Q factor to be determined. The effective diode capacitance and the cut-off frequency can be calculated taking L_s to be the typical value.

$$f_{co} = Q_o f_o \text{ where } f_o \text{ is the series resonant frequency}$$

$$\text{and } Q_o \text{ is the Q factor at zero bias}$$

$$\text{and } C_{mo} = \frac{1}{4\pi^2 f_o^2 L_s}$$

3. The capacitance variation coefficient γ is defined as

$$\gamma = \frac{C_m \text{ max.} - C_m \text{ min.}}{2(C_m \text{ max.} + C_m \text{ min.})}$$

where $C_m \text{ min.}$ = effective capacitance at $V_R = 1.0V$

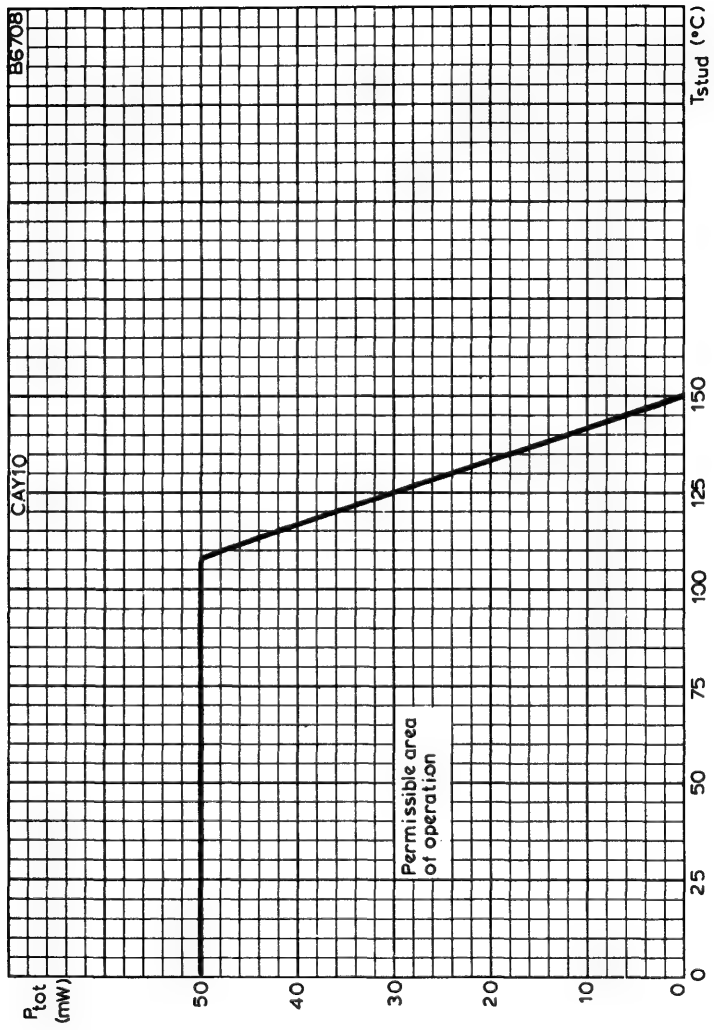
$C_m \text{ max.}$ = effective capacitance at $I_F = 1.0\mu A$

This can be re-written in the form

$$\gamma = \frac{(1-V)^{-\frac{1}{3}} - 2^{-\frac{1}{3}}}{2\left\{(1-V)^{-\frac{1}{3}} + 2^{-\frac{1}{3}}\right\} + \frac{4C_{S2}}{C_{jo}}}$$

where $V = V_F$ at $1.0\mu A$

$$C_{jo} = C_{mo} - C_{S2}$$



TOTAL DISSIPATION PLOTTED AGAINST STUD TEMPERATURE

GALLIUM ARSENIDE VARACTOR DIODE

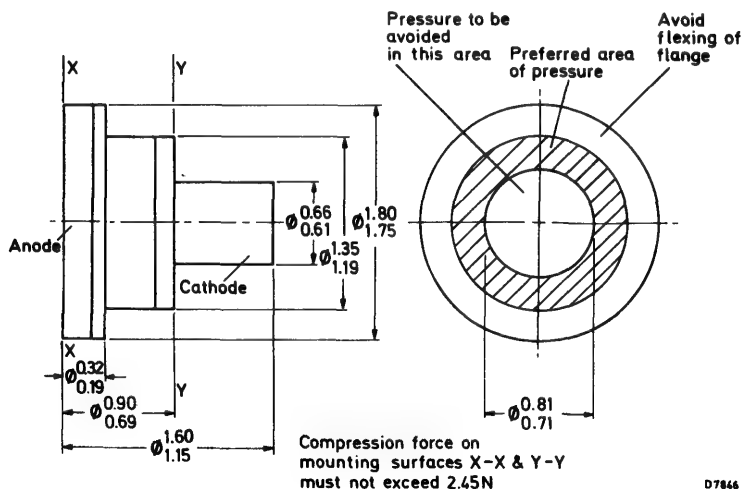
Gallium arsenide varactor diode with a high cut-off frequency suitable for use in parametric amplifiers and may be used in frequency multipliers and switches. The diodes are of the diffused mesa type, mounted in a small ceramic-metal case with a hermetic welded seal and conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

| | |
|--|---------|
| V_R max. | 6.0 V |
| P_{tot} max. $T_{pin} \leq 25^\circ C$ | 50 mW |
| Typical X-band parametric amplifier performance | |
| Signal frequency | 8.5 GHz |
| Gain | 15 dB |
| Bandwidth (3 dB) | 70 MHz |
| Noise temperature | 200 °K |

MECHANICAL DATA

Dimensions in mm



D7846

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltage

| | | | |
|----------------------------|-------|------|-------|
| Continuous reverse voltage | V_R | max. | 6.0 V |
|----------------------------|-------|------|-------|

Power dissipation

| | | | |
|---|-----------|------|-------|
| Total power dissipation ($T_{pin} \leq 25^\circ C$) | P_{tot} | max. | 50 mW |
|---|-----------|------|-------|

Temperatures

| | | | |
|--|-----------|---------------------------|--|
| Storage temperature | T_{stg} | - 196 to + 175 $^\circ C$ | |
| Junction temperature (operating range) | T_j | - 196 to + 135 $^\circ C$ | |

THERMAL RESISTANCE

| | | | |
|----------------------|-----------------|------|-------------------|
| From junction to pin | $R_{th\ j-pin}$ | max. | 0.9 $^\circ C/mW$ |
|----------------------|-----------------|------|-------------------|

CHARACTERISTICS

$T_{amb} = 25^\circ C$ unless otherwise stated

| | Min. | Typ. | Max. | |
|---|-----------------|------|------|-------------|
| Reverse current $V_R = 6.0\ V$ | I_R | — | 0.1 | 1.0 μA |
| Series resonant frequency $V_R = 0$ (note 1) | f_{res} | 27 | 30 | 34 GHz |
| Cut-off frequency $V_R = 0$ (note 1) | f_{co} | 200 | 350 | — GHz |
| Product of capacitance variation coefficient and cut-off frequency at $V_R = 0\ V$ (note 2) | γf_{co} | 35 | 50 | — GHz |
| Microwave value of effective device series resistance (notes 1, 4) | R_m | — | 2.25 | — Ω |
| Microwave value of effective device capacitance $V_R = 0\ V$ (notes 3, 4) | C_m | — | 0.2 | — pF |
| Stray capacitance (L.F. measurement) | C_s | — | 0.3 | — pF |
| Microwave value of effective device series inductance (note 3) | L_s | — | 140 | — pH |



Notes

1. Measured in a reduced height waveguide holder at Q-band.
2. γ_{fc} is guaranteed by a functional X-band paramp test at room temperature.

The capacitance variation coefficient, γ , is defined as follows:

$$\gamma = \frac{C_m(\max) - C_m(\min)}{2[C_m(\max) + C_m(\min)]}$$

where $C_m(\min)$ = capacitance at $V_R = 1.0$ V

$C_m(\max)$ = capacitance at $I_F = 1.0$ μ A

3. C_m is calculated using the frequency cut-off and the series resistance:

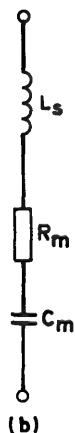
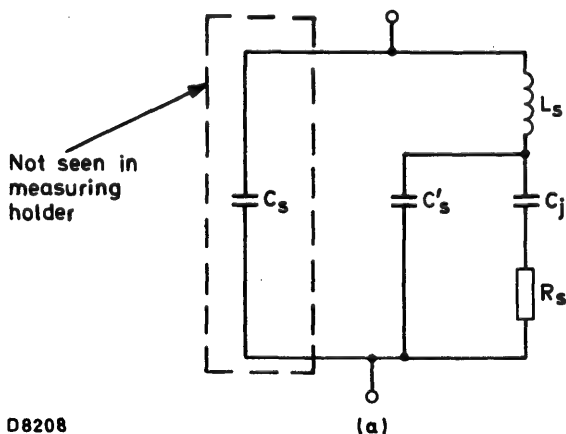
$$C_m = \frac{1}{2\pi R_m f_{co}}$$

L_s is also calculated using f_{res} and C_m :

$$L_s = \frac{1}{4\pi^2 f_{res}^2 C_m}$$

4. (a) Diode circuit model.

(b) Equivalent circuit in measuring holder.



D8208

Operating note

The CXY10 varactor diode will give good noise performance in a parametric amplifier of suitable design.

For example:

The effective input noise temperature of the amplifier, less the contribution due to the circulator, would be typically 200 °K and a maximum of 250 °K, with the amplifier at room temperature under the following conditions:

| | |
|-------------------|---------------|
| gain | 15 dB |
| bandwidth | 50 MHz (3 dB) |
| signal frequency | in X-band |
| overcoupled ratio | 4 to 5 dB |
| pump frequency | in Q-band |

In cooled parametric amplifiers, the device would give appropriately lower effective input noise temperatures due to its low temperature working capability.

Devices and alternative encapsulations
may be selected to suit customers'
specific requirements



GALLIUM ARSENIDE VARACTOR DIODE

CXY12

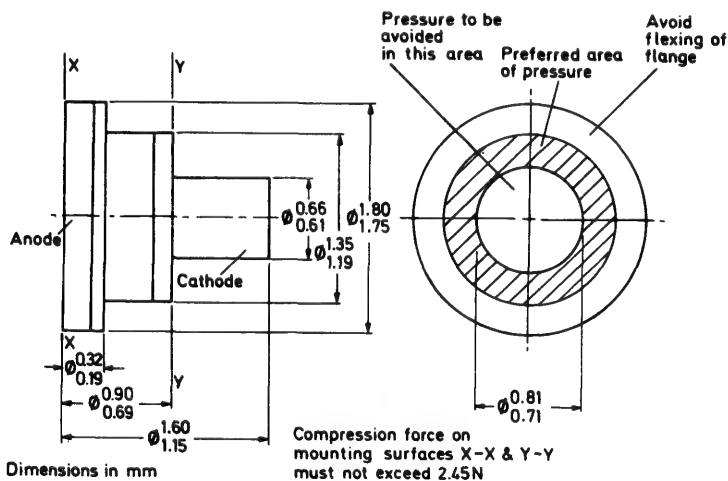
Gallium arsenide varactor diode suitable for use in frequency multiplier circuits ← up to Q-band output frequency. The diodes are of the diffused mesa type, are mounted in a small ceramic-metal case with hermetic welded seal and conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency quadrupler 9.0 GHz to 36 GHz in a typical circuit: -

| | | |
|---|-----|-----|
| P_{in} max. | 500 | mW |
| P_{out} min. | 50 | mW |
| Resistive cut-off frequency typ. ($V_R = 6.0$ V) | 500 | GHz |
| T_j max. | 175 | °C |

OUTLINE AND DIMENSIONS



RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|---|-----|----|
| V_R max. | 10 | V |
| P_{tot} max. ($T_{pin} = 25^{\circ}C$) (see note 1) | 300 | mW |
| P_{in} R.F. max. | 500 | mW |

Temperature

| | | |
|----------------|------|-------------|
| T_{stg} min. | -55 | $^{\circ}C$ |
| T_{stg} max. | +175 | $^{\circ}C$ |
| T_j max. | +175 | $^{\circ}C$ |

THERMAL CHARACTERISTIC

| | | |
|----------------------|-----|---------|
| $R_{th(j-pin)}$ max. | 0.5 | degC/mW |
|----------------------|-----|---------|

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}C$)

| | | Min. | Typ. | Max. | |
|-------------|--|------|-------|------|----------|
| $V_{(BR)R}$ | Breakdown voltage $I_R = 100\mu A$ | 10 | 15 | - | V |
| I_R | Reverse current $V_R = 6.0V$ | - | 0.001 | 1.0 | μA |
| f_{res} | Series resonance frequency $V_R = 6.0V$ (see note 2) | 27 | 29 | 35 | GHz |
| f_{co} | Cut-off frequency $V_R = 6.0V$ (see note 2) | 300 | 500 | - | GHz |
| C_m | Microwave value of effective device capacitance $V_R = 6.0V$ (see note 3) | - | 0.25 | - | pF |
| R_m | Microwave value of effective device series resistance $V_R = 6.0V$ (see notes 2 and 4) | - | 1.3 | - | Ω |
| C_s | Stray case capacitance (L.F. measurement) | - | 0.3 | - | pF |
| L_s | Microwave value of effective device series inductance (see note 3) | - | 120 | - | pH |

Notes

1. The maximum value of P_{tot} is based on a d.c. dissipation life test. The R.F. power may well exceed this figure in a practical circuit.
2. Measurements on semiconductor devices at microwave frequencies are very much dependent upon the kind of holder used. The dynamic parameters are quoted using a holder which takes the form of a double four section Q-band (Ka-band) 26 to 40GHz waveguide wide band low v.s.w.r. transformer to a reduced height of 0.25mm. The transformer is step down followed by step up in order to use standard Q-band components on either side. A d.c. isolated coaxial choke system allows the diode to be inserted across the 0.25mm reduced height section and to be biased.

Using a swept frequency transmission loss measurement system, the series resonant frequency and the Q of the diode holder system can be measured. Hence the resistive cut-off frequency which is defined as $Q \times f_{res}$.

Separately, by measuring the transmission loss past the diode at resonance, the effective diode series resistance can be found.

3. C_m is calculated using the frequency cut-off and the series resistance

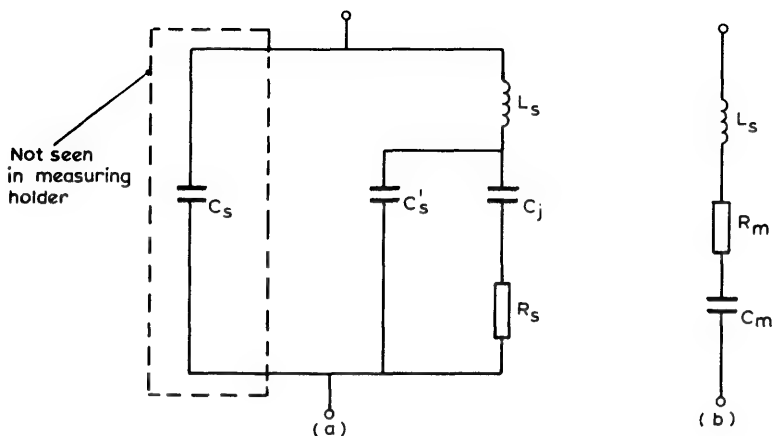
$$C_m = \frac{1}{2\pi R_m f_{co}}$$

L_s is also calculated using f_{res} and C_m

$$L_s = \frac{1}{4\pi^2 f_{res}^2 C_m}$$

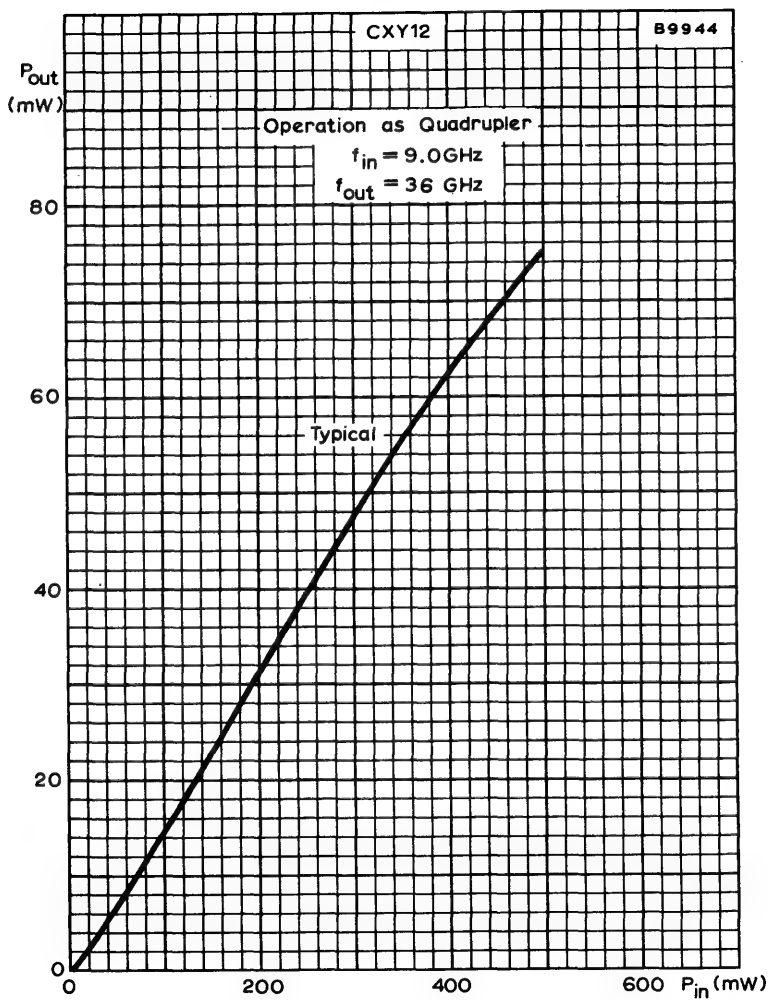
4. (a) Diode circuit model.

(b) Equivalent circuit in measuring holder.



→ Application note

In a suitable frequency quadrupler, this device is capable of producing 50mW at 36GHz for an input power of 400mW at 9.0GHz.



**OUTPUT POWER AGAINST INPUT POWER
QUADRUPLER OPERATION**

GALLIUM ARSENIDE LIMITER DIODES

**CXY22A
CXY22B**

Gallium arsenide varactor diodes for limiter applications from C to X-band. Very low insertion loss and high isolation characteristics may be obtained. The diodes are of the diffused mesa type and are mounted in standard microwave packages. They conform to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

| | CXY22A | CXY22B | |
|--------------------------------|------------|-----------|-----|
| Operating frequency range | 2.0 to 7.0 | 7.0 to 12 | GHz |
| C_T at 0V (typ.) | 0.85 | 0.55 | pF |
| Insertion loss* (typ.) | 0.2 | 0.3 | dB |
| High power attenuation* (typ.) | 20 | 16 | dB |

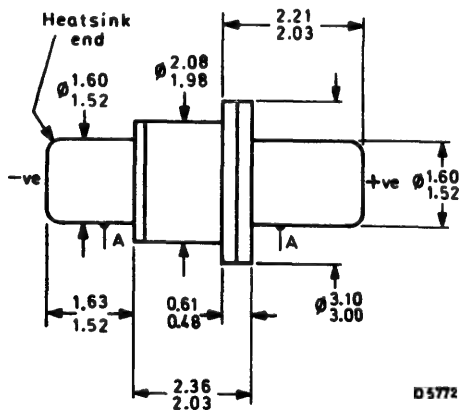
*Depends on circuit configuration, see page 2

Unless otherwise shown, data is applicable to both types.

OUTLINE AND DIMENSIONS

Dimensions in mm

Conforms to B.S. 3934 SO-86



D5772

A = concentricity tolerance = ± 0.13

LIMITING VALUES (Absolute max. rating system)

| | | | |
|-----------------|------|-------------|----|
| V_R | max. | 6.0 | V |
| T_{stg} range | | -55 to +150 | °C |
| T_{amb} range | | -55 to +100 | °C |

CHARACTERISTICS

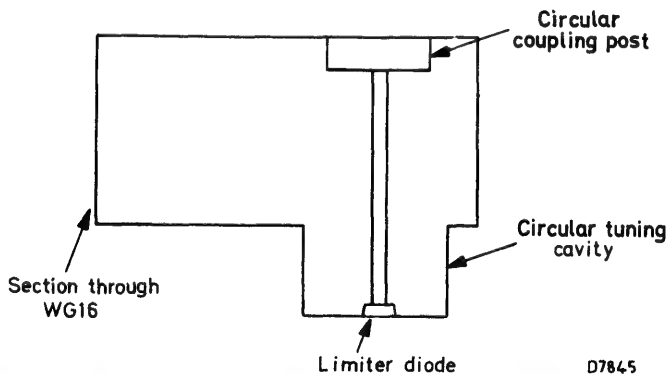
| | | CXY22A | CXY22B | |
|-----------------------------------|------|--------|--------|----|
| I_R at $V_R = 6$ V | max. | 1.0 | 1.0 | μA |
| C_T at $V_R = 0$ V, $f = 1$ MHz | typ. | 0.85 | 0.55 | pF |
| V_F at $I_F = 50$ mA | max. | 1.45 | 1.45 | V |
| R_S at $V_R = 0$ V | typ. | 1.0 | 1.2 | Ω |

TYPICAL X-BAND LIMITER USING CXY22B

This is a resonant circuit in rectangular waveguide, operating by reflection of a high power input.

| | | | |
|--|--------------|-----|-----|
| Centre frequency | f_0 | 9.4 | GHz |
| Bandwidth (v. s. w. r. = 1.2:1) at 1 mW max. | Δf_0 | 300 | MHz |
| Insertion loss at 1 mW max. | | 0.3 | dB |
| Insertion loss at 100 mW (c. w.) | | 6.0 | dB |
| Insertion loss at 5 W (pk), p. r. f. 1 kHz, 1 μs | | 16 | dB |
| Safe peak power handling*, p. r. f. 1 kHz, 1 μs | | 50 | W |

*Peak power handling depends on pulse length and duty cycle, as well as circuit design.



A particular diode specification within this range should be selected to suit a particular customer's requirement. It is recommended that the diode is functionally tested by the supplier, in the customer's circuit.

Requests for devices in alternative packages will be considered by the supplier.

GALLIUM ARSENIDE VARACTOR DIODES

**CXY23A
CXY23B
CXY23C
CXY23D**

Gallium arsenide Schottky barrier diodes having a low series resistance and a wide capacitance range. This ensures low losses with a wide tuning range in microwave applications. They conform to the environmental requirements of BS 9300 where applicable.

QUICK REFERENCE DATA

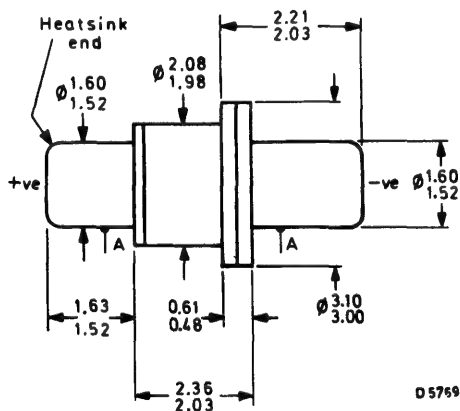
| | | |
|-------------------------------|--------|--------|
| $V_{(BR)R}$ (min.) | 12 | V |
| V_R (max.) | 12 | V |
| C_j (at $V_R = 0V$) (typ.) | CXY23A | 1.0 pF |
| | CXY23B | 1.5 pF |
| | CXY23C | 2.0 pF |
| | CXY23D | 3.0 pF |

(Development Nos. 821CXY/A, B, C and D)

Unless otherwise stated, data is applicable to all types.

OUTLINE AND DIMENSIONS

Conforms to BS 3934 SO-86



A = concentricity tolerance = ± 0.13

All dimensions in mm

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

V_R (max.)* 12 V

TEMPERATURE

range -65 to +150 °C

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25\text{ }^{\circ}\text{C}$)

| | | Min. | Typ. | Max. | |
|----------------------|--|--------|------|------|----------|
| $V_{(BR)R}$ | | 12 | - | - | V |
| C_j ($V_R = 0V$) | CXY23A | 0.8 | 1.0 | 1.2 | pF |
| | CXY23B | 1.2 | 1.5 | 1.8 | pF |
| | CXY23C | 1.6 | 2.0 | 2.5 | pF |
| | CXY23D | 2.5 | 3.0 | 3.5 | pF |
| Capacitance ratio | $\frac{C_j (V_R = 0V)}{C_j (V_R = 12V)}$ | 3.0: 1 | - | - | |
| R_S ($V_R = 0V$) | CXY23A | - | - | 3.0 | Ω |
| | CXY23B | - | - | 2.0 | Ω |
| | CXY23C | - | - | 1.5 | Ω |
| | CXY23D | - | - | 1.0 | Ω |
| Pacakage capacitance | | - | 0.2 | - | pF |
| V_R | | - | - | 12 | V |

*Versions of these diodes with V_R (max.) up to 30V may be made available to special order.

These devices may be supplied in alternative packages to suit customers' specific requirements

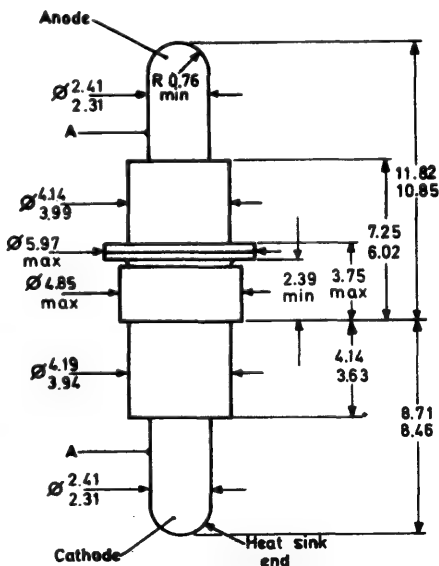
IN5152
IN5153

↑

Operation as a frequency doubler 1.0 to 2.0 GHz in a typical circuit.

1

OUTLINE DRAWING OF 1N5153



D7840

All dimensions in mm

JUNE 1977

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|--|-----|---|
| V_R max. | 75 | V |
| P_{tot} max. R. F. ($T_{pin} \leq 70^{\circ}\text{C}$) | 5.0 | W |

Temperature

| | | |
|----------------|------|--------------------|
| T_{stg} min. | -55 | $^{\circ}\text{C}$ |
| T_{stg} max. | +175 | $^{\circ}\text{C}$ |
| T_j max. | +175 | $^{\circ}\text{C}$ |

THERMAL CHARACTERISTIC

| | | |
|----------------------|----|--------|
| $R_{th(j-pin)}$ max. | 20 | degC/W |
|----------------------|----|--------|

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$)

| | | Min. | Typ. | Max. | |
|-------------|---|------|-------|------|---------------|
| $V_{BR(R)}$ | Reverse breakdown voltage ($I_R = 10\mu\text{A}$) | 75 | - | - | V |
| I_R | Reverse current ($V_R = 60\text{V}$) | - | 0.001 | 1.0 | μA |
| V_F | Forward voltage ($I_F = 10\text{mA}$) | - | - | 1.0 | V |
| f_{co} | Cut-off frequency ($V_R = 6.0\text{V}$, $f_{measured} = 2.0\text{GHz}$) | 55 | 100 | - | GHz |
| C_T | Total capacitance ($V_R = 6.0\text{V}$, $f = 1.0\text{MHz}$) | 5.0 | - | 7.5 | pF |
| η | Overall efficiency $P_{in} = 12\text{W}$, $f_{in} = 1.0\text{GHz}$ frequency doubler | 50 | 60 | - | % |

SILICON PLANAR EPITAXIAL
VARACTOR DIODE

1N5155

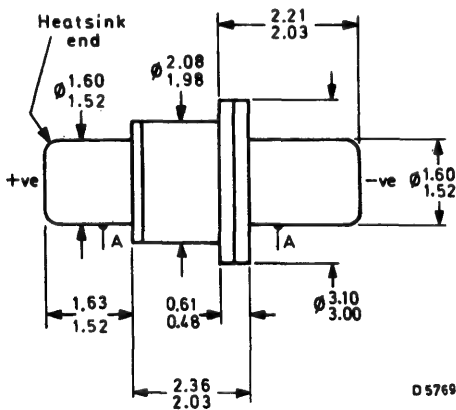
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to C-band output frequency. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operating as a frequency tripler 2.0 to 6.0 GHz in a typical circuit.

| | | |
|--|-----|-----|
| P_{in} | 5.0 | W |
| P_{out} | 2.0 | W |
| Typical resistive cut-off frequency ($V_R = 6.0\text{ V}$) | 120 | GHz |
| Typical total capacitance ($V_R = 6.0\text{ V}$) | 2.0 | pF |

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|--|-----|---|
| V_R max. | 35 | V |
| P_{tot} max. R. F. ($T_{pin} \leq 70^\circ\text{C}$) | 3.0 | W |

Temperature

| | | |
|----------------|------|------------------|
| T_{stg} min. | -55 | $^\circ\text{C}$ |
| T_{stg} max. | +175 | $^\circ\text{C}$ |
| T_j max. | +175 | $^\circ\text{C}$ |

THERMAL CHARACTERISTIC

| | | |
|----------------------|----|--------|
| $R_{th(j-pin)}$ max. | 35 | degC/W |
|----------------------|----|--------|

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^\circ\text{C}$)

| | | Min. | Typ. | Max. | |
|-------------|--|------|-------|------|---------------|
| $V_{BR(R)}$ | Reverse breakdown voltage ($I_R = 10\mu\text{A}$) | 35 | - | - | V |
| I_R | Reverse current ($V_R = 26\text{V}$) | - | 0.001 | 1.0 | μA |
| V_F | Forward voltage ($I_F = 10\text{mA}$) | - | - | 1.0 | V |
| f_{co} | Cut-off frequency ($V_R = 6.0\text{V}$, $f_{measured} = 2.0\text{GHz}$) | 100 | 120 | - | GHz |
| C_T | Total capacitance ($V_R = 6.0\text{V}$, $f = 1.0\text{MHz}$) | 1.0 | - | 3.0 | pF |
| η | Overall efficiency $P_{in} = 5.0\text{W}$, $f_{in} = 2.0\text{GHz}$ frequency tripler | 40 | - | - | % |

SILICON PLANAR EPITAXIAL VARACTOR DIODE

IN5157

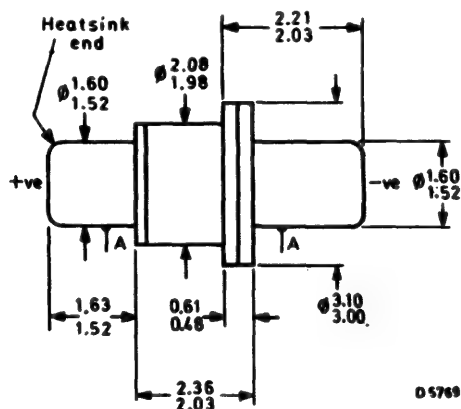
Silicon planar epitaxial varactor diode exhibiting step recovery characteristics, especially suitable for use in frequency multiplier circuits up to X-band output frequency. It conforms to the environmental requirements of BS9300 where applicable.

QUICK REFERENCE DATA

Operation as a frequency doubler 5.0 to 10 GHz in a typical circuit.

| | | |
|--|-----|-----|
| P_{in} | 2.6 | W |
| P_{out} | 1.0 | W |
| Typical resistive cut-off frequency ($V_R = 6.0$ V) | 200 | GHz |
| Typical total capacitance ($V_R = 6.0$ V) | 0.8 | pF |

OUTLINE AND DIMENSIONS



A = concentricity tolerance = ± 0.13

All dimensions in mm

Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

Electrical

| | | |
|---|-----|---|
| V_R max. | 20 | V |
| P_{tot} max. R.F. ($T_{pin} \leq 70^\circ\text{C}$) | 2.5 | W |

Temperature

| | | |
|----------------|------|------------------|
| T_{stg} min. | -55 | $^\circ\text{C}$ |
| T_{stg} max. | +175 | $^\circ\text{C}$ |
| T_j max. | +175 | $^\circ\text{C}$ |

THERMAL CHARACTERISTIC

| | | |
|----------------------|------|--------|
| $R_{th(j-pin)}$ max. | 38.5 | degC/W |
|----------------------|------|--------|

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^\circ\text{C}$)

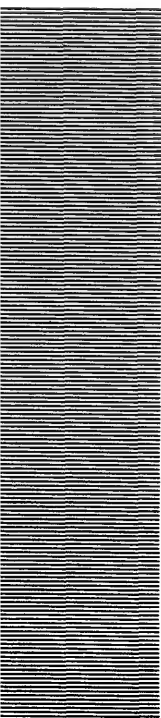
| | | Min. | Typ. | Max. | |
|-------------|--|------|------|------|---------------|
| $V_{BR(R)}$ | Reverse breakdown voltage ($I_R = 10\mu\text{A}$) | 20 | - | - | V |
| I_R | Reverse current ($V_R = 16\text{V}$) | - | - | 0.1 | μA |
| V_F | Forward voltage ($I_F = 10\text{mA}$) | - | - | 1.0 | V |
| f_{co} | Cut-off frequency ($V_R = 6.0\text{V}$, $f_{measured} = 8.0\text{GHz}$) | 180 | 200 | - | GHz |
| C_T | Total capacitance ($V_R = 6.0\text{V}$, $f = 1.0\text{MHz}$) | 0.6 | - | 1.0 | pF |
| η | Overall efficiency $P_{in} = 2.6\text{W}$, $f_{in} = 5.0\text{GHz}$ frequency doubler | 38 | - | - | % |

GUNN OSCILLATORS

F



F



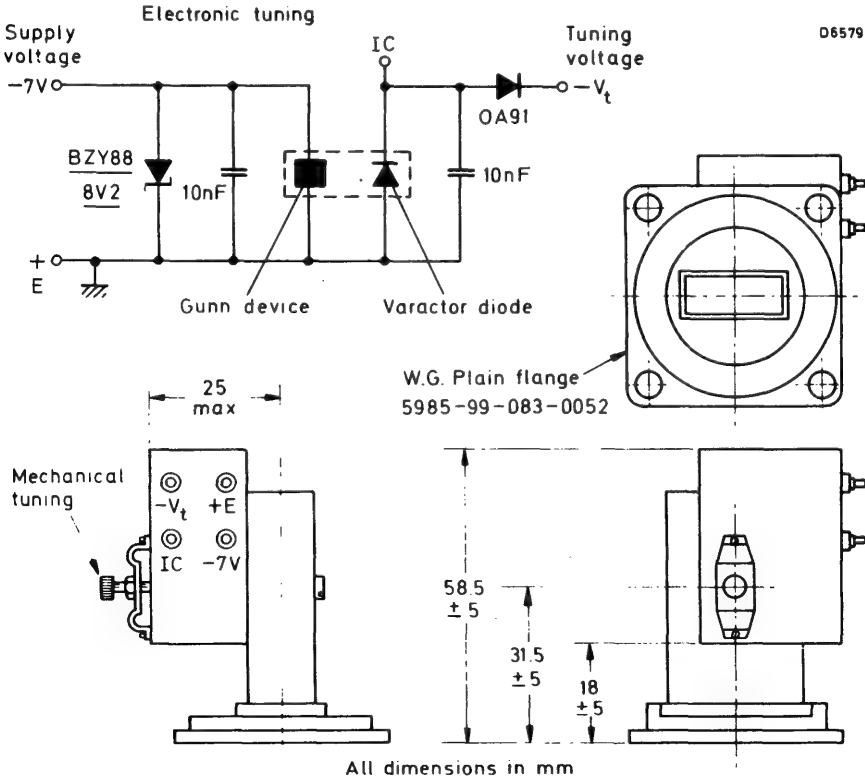
**X-BAND GUNN
OSCILLATOR**

CL8310

QUICK REFERENCE DATA

Solid state oscillator featuring wide electronic tuning range. For application in local oscillators employing A. F. C. systems.

| | | |
|--------------------------------|---------------|-----|
| Output connector | WG. 16/WR. 90 | |
| Centre frequency | 9.4 | GHz |
| Mechanical tuning range (min.) | ±50 | MHz |
| Electronic tuning range (min.) | 200 | MHz |
| Power output (typ.) | 5.0 | mW |
| Operating voltage | -7.0 | V |



OPERATING CONDITIONS

| | | |
|---------------------------|----------|----|
| Supply voltage (see note) | -7.0 | V |
| Supply current | 140 | mA |
| Tuning voltage | 0 to -10 | V |
| Tuning current | 1.0 | mA |
| P _{out} | 5.0 | mW |

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

| | | |
|-----------------------------|-------|----|
| Supply voltage max. | -8.0 | V |
| Supply current max. running | 200 | mA |
| starting | 250 | mA |
| Tuning voltage max. | -12 | V |
| Tuning current max. | 2.0 | mA |
| Load v.s.w.r. max. | 1.5:1 | |

CHARACTERISTICS at 25°C

| | | | | |
|--|------|------|------|----------|
| Centre frequency | 9.4 | | | GHz |
| | Min. | Typ. | Max. | |
| Mechanical tuning range | ±50 | - | - | MHz |
| Electronic tuning range | 200 | 250 | - | MHz |
| *P _{out} | 3.0 | 5.0 | - | mW |
| Variation in P _{out} over electronic tuning range | - | 1.5 | - | dB |
| Electronic tuning sensitivity | - | 25 | - | MHz/V |
| Frequency temperature coefficient | - | -1.0 | - | MHz/degC |
| Frequency pushing | - | 30 | - | MHz/V |

*P_{out} min. measured under all conditions of tuning.

TEMPERATURE

| | | |
|------------|------------|----|
| Range max. | -30 to +70 | °C |
|------------|------------|----|

OPERATING NOTE

The active element will be damaged if the supply voltage is reversed. The oscillator circuit provides some protection against forward transients greater than -8V but care should be taken to avoid such transients as far as possible.

X-BAND GUNN OSCILLATOR

CL8630

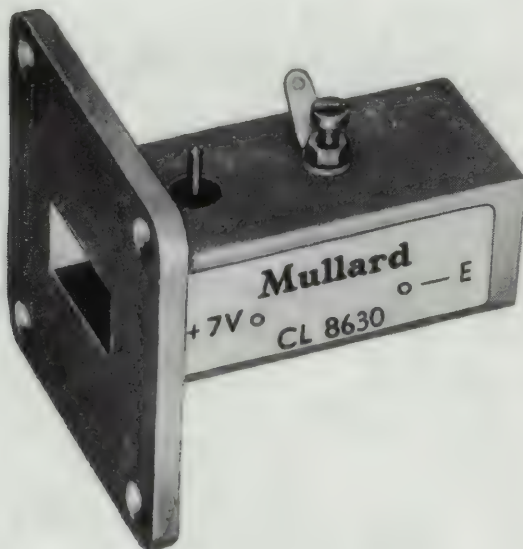
QUICK REFERENCE DATA

Fixed frequency Gunn oscillator for operation in the 10.7GHz band. Applications include all forms of miniature radar systems.

| | | |
|---|--------|--------|
| Centre frequency | 10.687 | GHz |
| Power output (at 7V) typical | 8.0 | mW |
| Frequency temperature coefficient | -0.25 | MHz/°C |
| Output via square plain flange WG16. WR90. 5985-99-083-0052 | | |

OPERATING CONDITIONS

| | | |
|--------------------------------------|--------|----|
| Supply voltage (see operating notes) | +7.0 | V |
| Load v.s.w.r. max. | 1.5: 1 | |
| Starting current max. | 200 | mA |
| Running current max. | 160 | mA |



Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

| | | |
|-----------------------------|--------|----|
| Supply voltage max. | +7.5 | V |
| Supply current max. running | 160 | mA |
| starting | 200 | mA |
| Load v.s.w.r. max. | 1.5: 1 | |

CHARACTERISTICS at 25°C

| | | | | |
|---|--------|--------|--------|--------|
| Centre frequency | | 10.687 | | GHz |
| | Min. | Typ. | Max. | |
| Power output (at 7.0V) | 5.0 | 8.0 | - | mW |
| Frequency (fixed) | 10.675 | 10.687 | 10.699 | GHz |
| Frequency temperature coefficient | - | -0.25 | -0.4 | MHz/°C |
| Frequency pushing | - | 1.5 | - | MHz/V |
| → A.M. noise to carrier ratio (1Hz to 1 kHz bandwidth) | | -94 | | dB |
| Second harmonic | | -35 | | dBm |

TEMPERATURE

| | | |
|------------|----------|----|
| Range max. | 0 to +40 | °C |
|------------|----------|----|

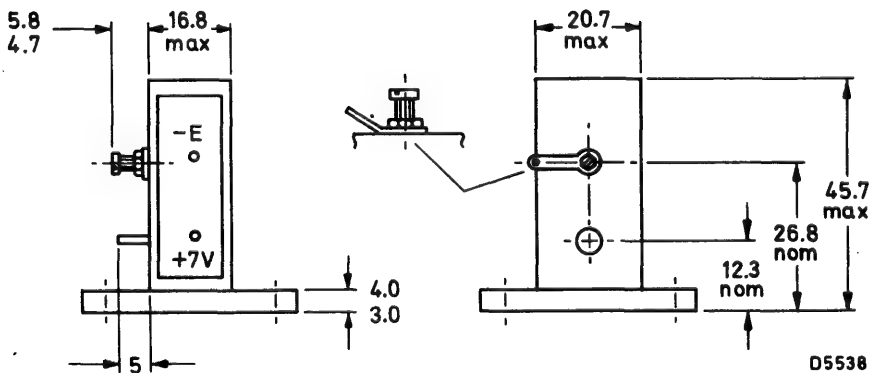
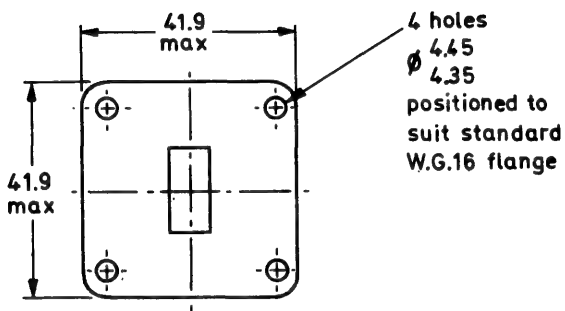
OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in excess of 8 volts. An 8.2V voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. Modulation of the supply voltage within the 1 Hz to 1 kHz bandwidth will degrade the a.m. noise to carrier ratios as a result of direct conversion by the Gunn device to both a.m. and f.m. noise components. The f.m. component may be demodulated by the non-linear response characteristic of the associated detecting element.

X-BAND GUNN OSCILLATOR

CL8630

OUTLINE DRAWING



X-BAND GUNN OSCILLATOR

CL8630S

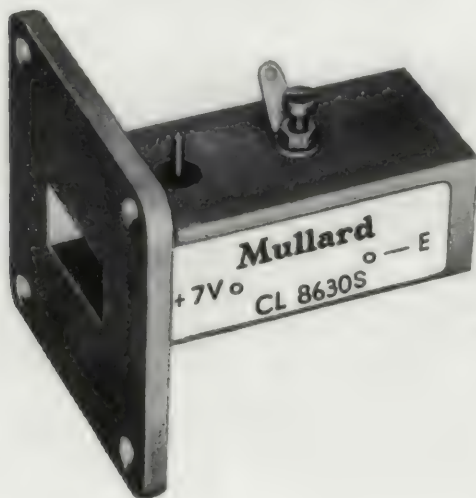
QUICK REFERENCE DATA

Fixed frequency Gunn oscillator for operation in the 10.7GHz band as a self-oscillating mixer (auto detector).

| | | |
|---|--------|--------|
| Centre frequency | 10.687 | GHz |
| Power output (at 7V) typical | 8.0 | mW |
| Frequency temperature coefficient | -0.25 | MHz/°C |
| Output via square plain flange WG16. WR90. 5985-99-083-0052 | | |

OPERATING CONDITIONS

| | | |
|--------------------------------------|-------|----|
| Supply voltage (see operating notes) | +7.0 | V |
| Load v.s.w.r. max. | 1.5:1 | |
| Threshold current max. | 200 | mA |
| Operating current max. | 160 | mA |



Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

| | | |
|---|------|---|
| Supply voltage max. (d.c.) | +7.5 | V |
| Supply voltage max. (for less than 1ms) | +9.0 | V |

CHARACTERISTICS at 25°C

| | | | | |
|--|--------|--------|--------|--------|
| Centre frequency | 10.687 | | | GHz |
| | Min. | Typ. | Max. | |
| Power output (at 7.0V) | 5.0 | 8.0 | - | mW |
| Frequency (fixed) | 10.675 | 10.687 | 10.699 | GHz |
| Frequency temperature coefficient | - | -0.25 | -0.4 | MHz/°C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| → Output voltage for input 66dB down on output power (at 12 dB min. <u>signal + noise</u>) noise | 80 | 120 | - | μV |
| Second harmonic | - | -35 | - | dBm |
| Threshold current | - | - | 200 | mA |
| Operating current | - | 120 | 160 | mA |

TEMPERATURE

| | | |
|------------|----------|----|
| Range max. | 0 to +40 | °C |
|------------|----------|----|

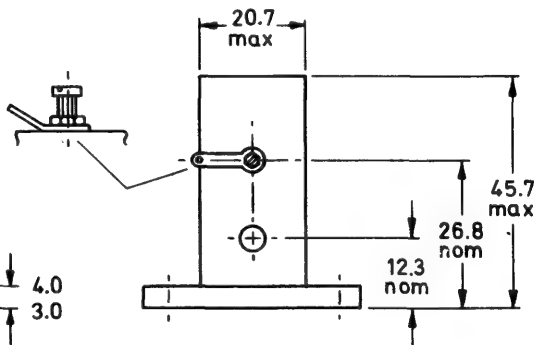
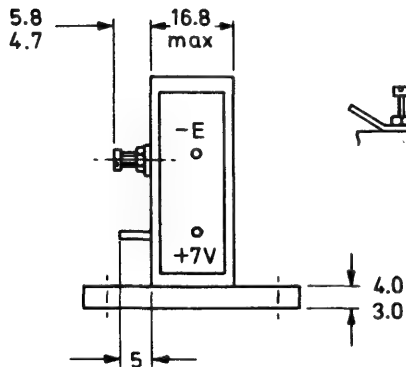
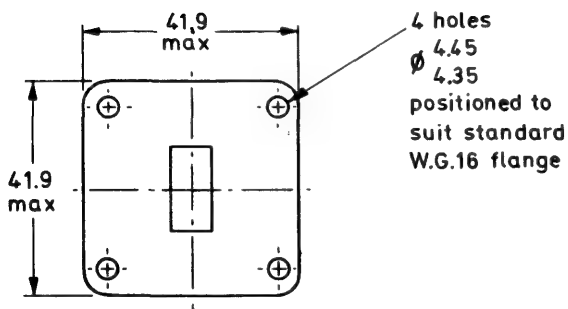
OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section 1.0m² at a range of 12m, when operating with an antenna gain of 20dB.
5. System bandwidth 1Hz to 1kHz.
6. Power supply ripple in the amplifier passband will degrade the signal to noise performance.

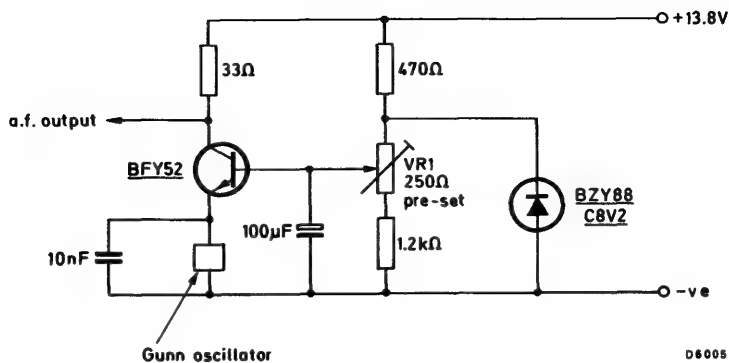
X-BAND GUNN OSCILLATOR

CL8630S

OUTLINE DRAWING



D5538



VR₁ is used to set voltage at 7.0V across Gunn oscillator.

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

X-BAND GUNN OSCILLATOR

CL8631

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator for operation in the 9.35GHz band. Applications include all forms of miniature radar systems.

| | | |
|---|-------|--------|
| Centre frequency | 9.35 | GHz |
| Power output (at 7V) typical | 8.0 | mW |
| Frequency temperature coefficient | -0.25 | MHz/°C |
| Output via square plain flange WG16, WR90. 5985-99-083-0052 | | |

OPERATING CONDITIONS

| | | |
|--------------------------------------|--------|----|
| Supply voltage (see operating notes) | +7.0 | V |
| Load v.s.w.r. max. | 1.5: 1 | |
| Starting current max. | 200 | mA |
| Running current max | 160 | mA |



Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

| | | |
|-----------------------------|--------|----|
| Supply voltage max. | +7.5 | V |
| Supply current max. running | 160 | mA |
| starting | 200 | mA |
| Load v.s. w. r. max. | 1.5: 1 | |

CHARACTERISTICS at 25°C

| | | | | |
|---|-------|-------|-------|----------|
| Centre frequency | | | 9.35 | GHz |
| | Min. | Typ. | Max. | |
| Power output (at 7.0V) | 5.0 | 8.0 | - | mW |
| Frequency (fixed) | 9.338 | 9.35 | 9.362 | GHz |
| Frequency temperature coefficient | - | -0.25 | -0.4 | MHz/degC |
| Frequency pushing | - | 1.5 | - | MHz/V |
| A. M. noise to carrier ratio (1Hz to 1kHz bandwidth) | | -94 | | dB |
| Second harmonic | | -25 | | dBm |

TEMPERATURE

| | | |
|------------|----------|----|
| Range max. | 0 to +40 | °C |
|------------|----------|----|

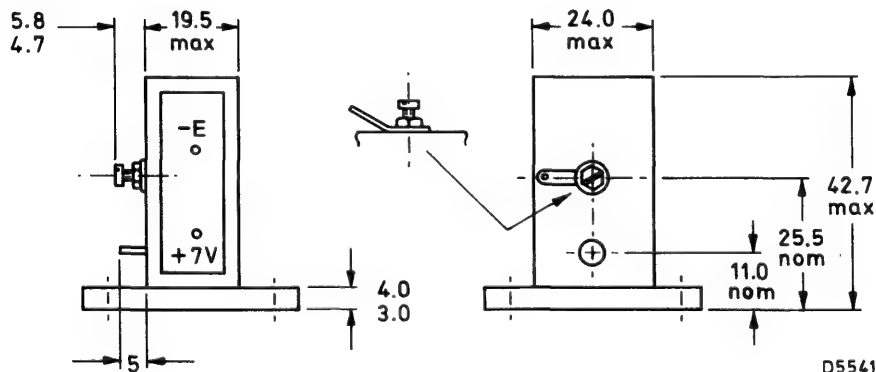
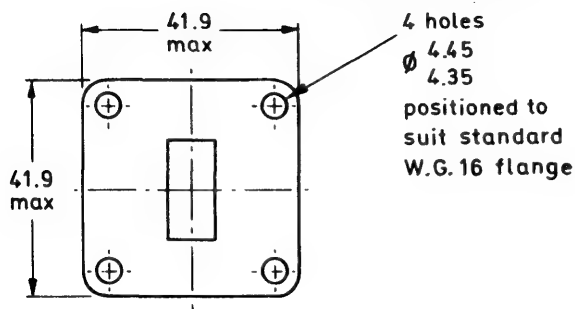
OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in excess of 8 volts. An 8.2V voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. Modulation of the supply voltage within the 1Hz to 1kHz bandwidth will degrade the a.m. noise to carrier ratio as a result of direct conversion by the Gunn device to both a.m. and f.m. noise components.

X-BAND GUNN OSCILLATOR

CL8631

OUTLINE DRAWING



X-BAND GUNN OSCILLATOR

CL8631S

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator for operation in the 9.35GHz band as a self-oscillating mixer (auto detector).

| | | |
|---|-------|--------|
| Centre frequency | 9.35 | GHz |
| Power output (at 7V) typical | 8.0 | mW |
| Frequency temperature coefficient | -0.25 | MHz/°C |
| Output via square plain flange WG16, WR90. 5985-99-083-0052 | | |

OPERATING CONDITIONS

| | | |
|--------------------------------------|-------|----|
| Supply voltage (see operating notes) | +7.0 | V |
| Load v.s.w.r. max. | 1.5:1 | |
| Threshold current max. | 200 | mA |
| Operating current max. | 160 | mA |



Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

| | | |
|---|------|---|
| Supply voltage max. (d.c.) | +7.5 | V |
| Supply voltage max. (for less than 1ms) | +9.0 | V |

CHARACTERISTICS at 25°C

| | | | | |
|--|-------|-------|-------|--------|
| Centre frequency | 9.35 | | | GHz |
| | Min. | Typ. | Max. | |
| Power output (at 7.0V) | 5.0 | 8.0 | - | mW |
| Frequency (fixed) | 9.338 | 9.35 | 9.362 | GHz |
| Frequency temperature coefficient | - | -0.25 | -0.4 | MHz/°C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| Output voltage for input 66dB down on output power (at 12dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$) | 80 | 120 | - | μV |
| Second harmonic | - | -25 | - | dBm |
| Threshold current | - | - | 200 | mA |
| Operating current | - | 120 | 160 | mA |

TEMPERATURE

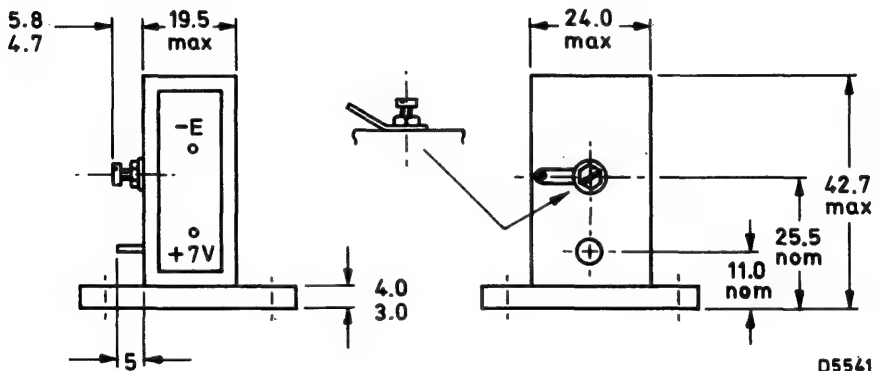
| | | |
|------------|----------|----|
| Range max. | 0 to +40 | °C |
|------------|----------|----|

OPERATING NOTES

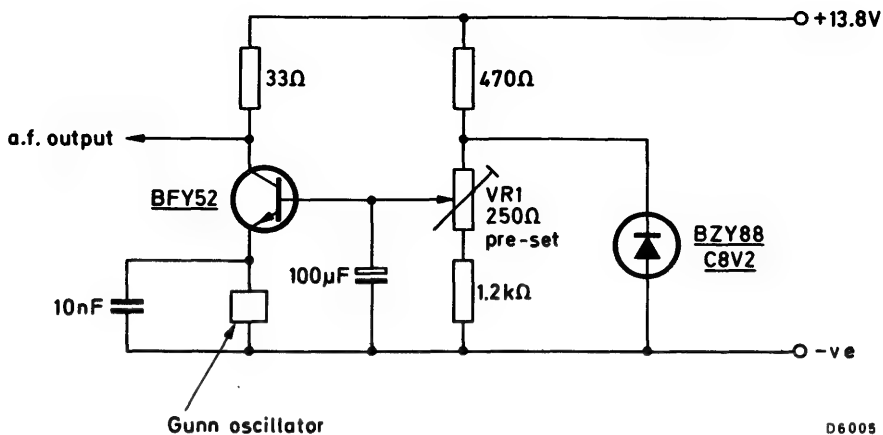
1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section 1.0m² at a range of 12m, when operating with an antenna gain of 20dB.
5. System bandwidth 1Hz to 1kHz.
6. Power supply ripple in the amplifier passband will degrade the signal to noise performance.

CL8631S

Technical drawing of a square flange. The overall dimensions are 41.9 max (width) and 41.9 max (height). There are four holes, each with a diameter of 4.45, positioned to suit standard W.G. 16 flange. The holes are arranged in a square pattern with a center-to-center distance of 41.9 max. A central rectangular slot is shown with a width of 10.0 max and a height of 10.0 max. The drawing includes dimension lines and a note: "4 holes 4.45 4.35 positioned to suit standard W.G. 16 flange".



D5541



VR₁ is used to set voltage at 7.0V across Gunn oscillator.

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

X-BAND GUNN OSCILLATOR

CL8632

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator for operation in the 9.47GHz band. Applications include all forms of miniature radar systems.

| | | |
|---|-------|--------|
| Centre frequency | 9.47 | GHz |
| Power output (at 7V) typical | 8.0 | mW |
| Frequency temperature coefficient | -0.25 | MHz/°C |
| Output via square plain flange WG16. WR90. 5985-99-083-0052 | | |

OPERATING CONDITIONS

| | | |
|--------------------------------------|--------|----|
| Supply voltage (see operating notes) | +7.0 | V |
| Load v.s.w.r. max. | 1.5: 1 | |
| Starting current max. | 200 | mA |
| Running current max. | 160 | mA |



RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

| | | |
|-----------------------------|--------|----|
| Supply voltage max. | +7.5 | V |
| Supply current max. running | 160 | mA |
| starting | 200 | mA |
| Load v.s.w.r. max. | 1.5: 1 | |

→ CHARACTERISTICS at 25°C

| | | | | |
|--|-------|-------|-------|-----------|
| Centre frequency | | | 9.35 | GHz |
| | Min. | Typ. | Max. | |
| Power output (at 7.0V) | 5.0 | 8.0 | - | mW |
| Frequency (fixed) | 9.458 | 9.47 | 9.482 | GHz |
| Frequency temperature coefficient | - | -0.25 | -0.4 | MHz/deg C |
| Frequency pushing | - | 1.5 | - | MHz/V |
| A.M. noise to carrier ratio (1Hz to 1kHz bandwidth) | | -94 | | dB |
| Second harmonic | | -25 | | dBm |

TEMPERATURE

| | | |
|------------|----------|----|
| Range max. | 0 to +40 | °C |
|------------|----------|----|

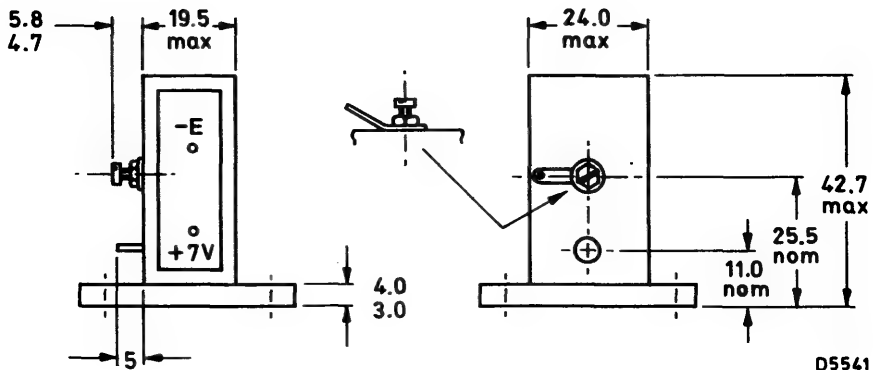
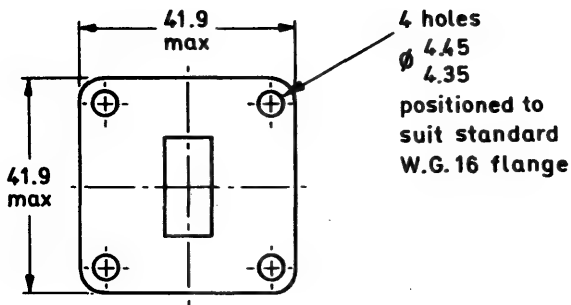
OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in excess of 8 volts. An 8.2V voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
- 4. Modulation of the supply voltage within the 1Hz to 1kHz bandwidth will degrade the a.m. noise to carrier ratio as a result of direct conversion by the Gunn device to both a.m. and f.m. noise components.

X-BAND GUNN OSCILLATOR

CL8632

OUTLINE DRAWING



X-BAND GUNN OSCILLATOR

CL8632S

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator for operation in the 9.47GHz band as a self-oscillating mixer (auto detector).

| | | |
|---|-------|--------|
| Centre frequency | 9.47 | GHz |
| Power output (at 7V) typical | 8.0 | mW |
| Frequency temperature coefficient | -0.25 | MHz/°C |
| Output via square plain flange WG16. WR90. 5985-99-083-0052 | | |

OPERATING CONDITIONS

| | | |
|--------------------------------------|-------|----|
| Supply voltage (see operating notes) | +7.0 | V |
| Load v.s.w.r. max. | 1.5:1 | |
| Threshold current max. | 200 | mA |
| Operating current max. | 160 | mA |



Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

| | | |
|---|------|---|
| Supply voltage max. (d.c.) | +7.5 | V |
| Supply voltage max. (for less than 1ms) | +9.0 | V |

→ CHARACTERISTICS at 25°C

| | | | | |
|--|-------|-------|-------|--------|
| Centre frequency | 9.47 | | | GHz |
| | Min. | Typ. | Max. | |
| Power output (at 7.0V) | 5.0 | 8.0 | - | mW |
| Frequency (fixed) | 9.458 | 9.47 | 9.482 | GHz |
| Frequency temperature coefficient | - | -0.25 | -0.4 | MHz/°C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| Output voltage for input 66dB down on output power (at 12dB min. <u>signal + noise</u> noise) | 80 | 120 | - | μV |
| Second harmonic | - | -25 | - | dBm |
| Threshold current | - | - | 200 | mA |
| Operating current | - | 120 | 160 | mA |

TEMPERATURE

| | | |
|------------|----------|----|
| Range max. | 0 to +40 | °C |
|------------|----------|----|

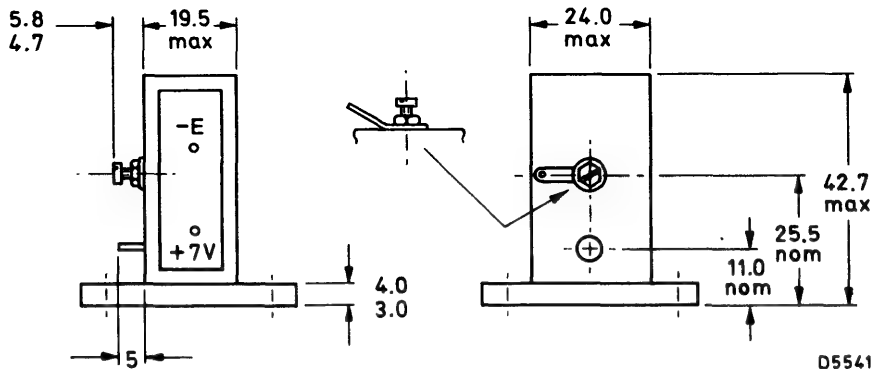
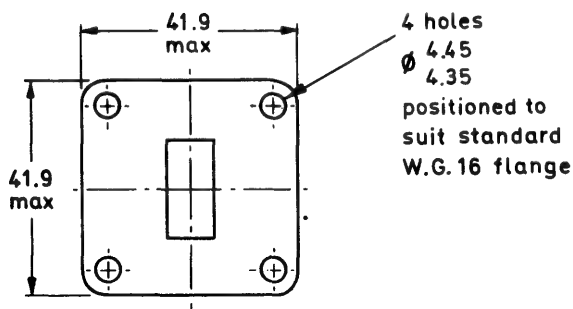
OPERATING NOTES

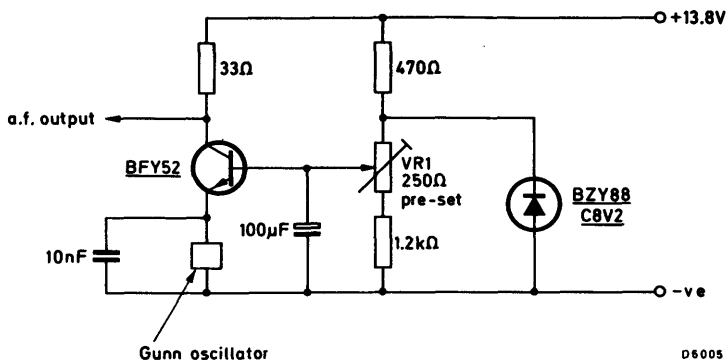
1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section 1.0m² at a range of 12m, when operating with an antenna gain of 20dB.
5. System bandwidth 1Hz to 1kHz.
6. Power supply ripple in the amplifier passband will degrade the signal to noise performance.

X-BAND GUNN OSCILLATOR

CL8632S

OUTLINE DRAWING





VR_1 is used to set voltage at 7.0V across Gunn oscillator.

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

X-BAND GUNN OSCILLATOR

CL8633

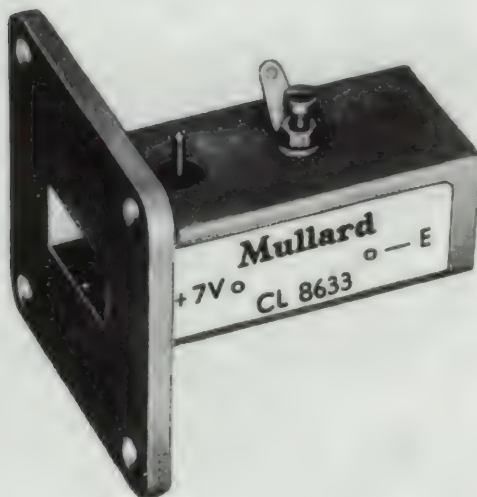
QUICK REFERENCE DATA

Fixed frequency Gunn oscillator for operation in the 10.5GHz band. Applications include all forms of miniature radar systems.

| | | |
|---|--------|--------|
| Centre frequency | 10.525 | GHz |
| Power output (at 7V) typical | 8.0 | mW |
| Frequency temperature coefficient | -0.25 | MHz/°C |
| Output via square plain flange WG16. WR90. 5985-99-083-0052 | | |

OPERATING CONDITIONS

| | | |
|--------------------------------------|-------|----|
| Supply voltage (see operating notes) | +7.0 | V |
| Load v.s.w.r. max. | 1.5:1 | |
| Threshold current max. | 200 | mA |
| Operating current max. | 160 | mA |



Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

| | | |
|--|------|---|
| Supply voltage max. (d.c.) | +7.5 | V |
| Supply voltage max. (for less than 1ms) | +9.0 | V |

→ CHARACTERISTICS at 25°C

| | | | | |
|--|--------|--------|--------|--------|
| Centre frequency | 10.525 | | | GHz |
| | Min. | Typ. | Max. | |
| Power output (at 7.0V) | 5.0 | 8.0 | - | mW |
| Frequency (fixed) | 10.513 | 10.525 | 10.537 | GHz |
| Frequency temperature coefficient | - | -0.25 | -0.4 | MHz/°C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| A.M. noise to carrier ratio (1Hz to 1kHz bandwidth) | | -94 | | dB |
| Second harmonic | | -35 | | dBm |

TEMPERATURE

| | | |
|------------|----------|----|
| Range max. | 0 to +40 | °C |
|------------|----------|----|

OPERATING NOTES

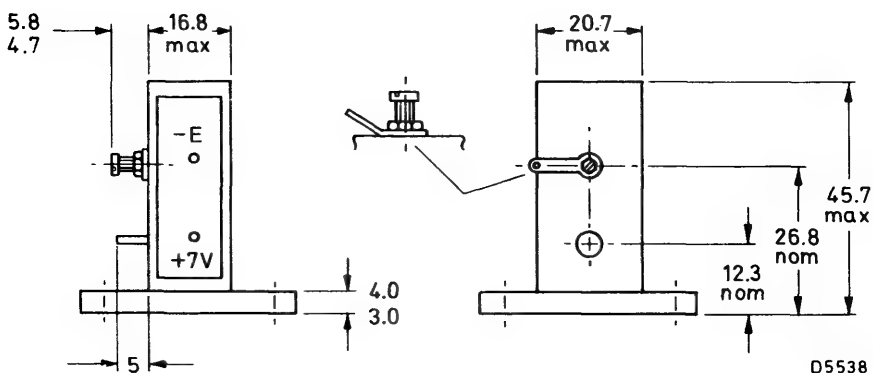
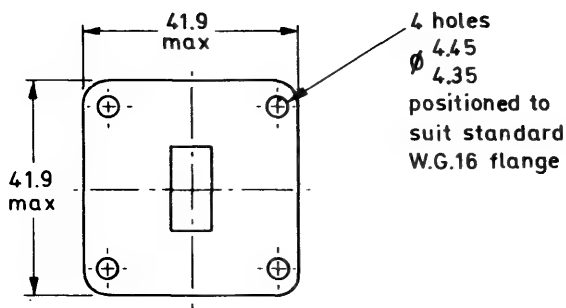
1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. When used in a Doppler radar system, modulation of the oscillator supply voltage will degrade the a.m. signal to noise ratio at the output of the associated mixer, as a result of direct conversion by the Gunn device to a.m. and f.m. noise components. The a.m. component will contribute directly and the f.m. component may contribute from demodulation by the slope of the bandpass characteristic of the mixer.
5. Second harmonic level is measured into a W.G.16 load with a v.s.w.r. <1.1:1 at fundamental frequency. The level is equivalent to that radiated from a low v.s.w.r. X-band antenna, for example, Mullard ACX-01A.

→

X-BAND GUNN OSCILLATOR

CL8633

OUTLINE DRAWING



D5538

X-BAND GUNN OSCILLATOR

CL8633S

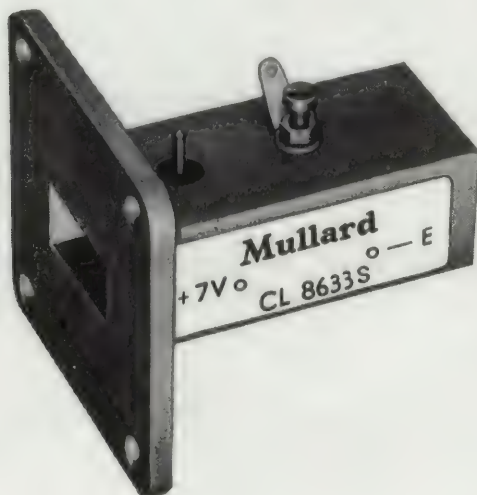
QUICK REFERENCE DATA

Fixed frequency Gunn oscillator for operation in the 10.5GHz band as a self-oscillating mixer (auto detector).

| | | |
|---|--------|--------|
| Centre frequency | 10.525 | GHz |
| Power output (at 7V) typical | 8.0 | mW |
| Frequency temperature coefficient | -0.25 | MHz/°C |
| Output via square plain flange WG16. WR90. 5985-99-083-0052 | | |

OPERATING CONDITIONS

| | | |
|--------------------------------------|-------|----|
| Supply voltage (see operating notes) | +7.0 | V |
| Load v.s.w.r. max. | 1.5:1 | |
| Threshold current max. | 200 | mA |
| Operating current max. | 160 | mA |



Mullard

RATINGS (ABSOLUTE MAXIMUM SYSTEM) at 25°C

| | | |
|---|------|---|
| Supply voltage max. (d.c.) | +7.5 | V |
| Supply voltage max. (for less than 1ms) | +9.0 | V |

→ CHARACTERISTICS at 25°C

| | | | | |
|--|--------|--------|--------|--------|
| Centre frequency | | | 10.525 | GHz |
| | Min. | Typ. | Max. | |
| Power output (at 7.0V) | 5.0 | 8.0 | - | mW |
| Frequency (fixed) | 10.513 | 10.525 | 10.537 | GHz |
| Frequency temperature coefficient | - | -0.25 | -0.4 | MHz/°C |
| Frequency pushing | - | 1.5 | - | MHz/V |
| Output voltage for input 66dB down on output power (at 12dB min. <u>signal + noise</u> noise) | 80 | 120 | - | μV |
| Second harmonic | - | -35 | - | dBm |
| Threshold current | - | - | 200 | mA |
| Operating current | - | 120 | 160 | mA |

TEMPERATURE

| | | |
|------------|----------|----|
| Range max. | 0 to +40 | °C |
|------------|----------|----|

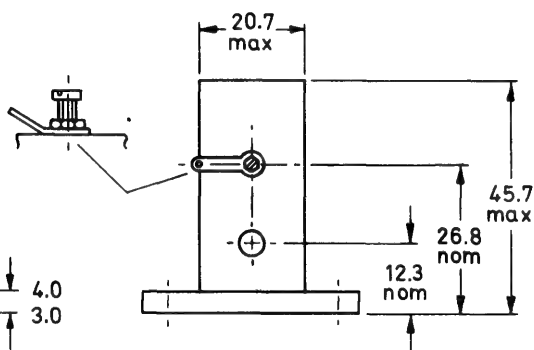
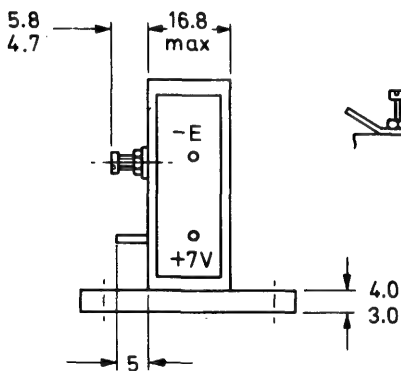
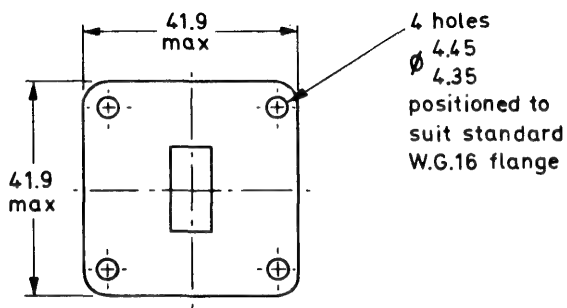
OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to limit transients. An 8.2V 5% voltage regulator diode to shunt the power supply is recommended for this purpose.
2. The minimum supply voltage is 6.5V for the frequency of oscillation to remain within the characteristic limits.
3. It is recommended that a small capacitor (e.g. 10nF) is connected across the oscillator supply voltage terminals to suppress low frequency oscillation which may occur in the power supply.
4. A return signal 66dB down on radiated power will be achieved from a man target of radar cross-section 1.0m² at a range of 12m, when operating with an antenna gain of 20dB.
5. System bandwidth 1Hz to 1kHz.
6. Power supply ripple in the amplifier passband will degrade the signal to noise performance.

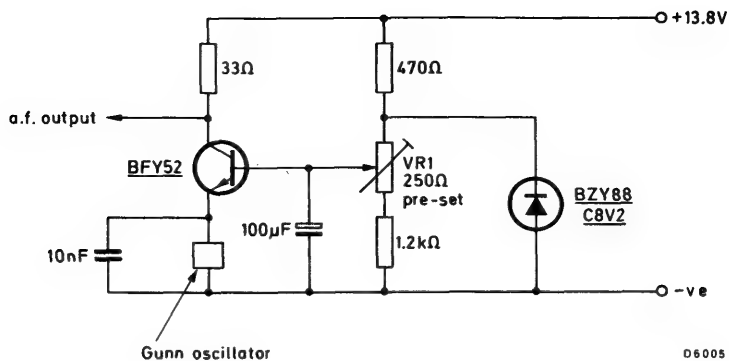
X-BAND GUNN OSCILLATOR

CL8633S

OUTLINE DRAWING



D5538



VR₁ is used to set voltage at 7.0V across Gunn oscillator.

CIRCUIT USED FOR SENSITIVITY MEASUREMENT

X-BAND GUNN OSCILLATOR

CL8640R CL8640T

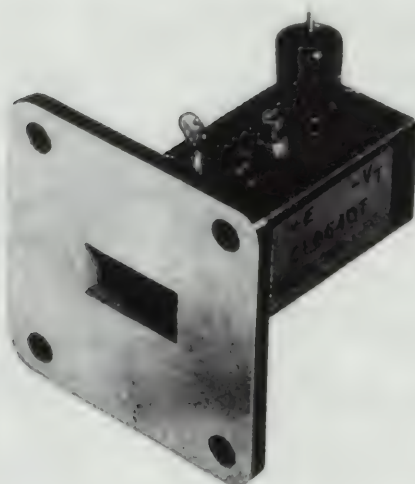
Mechanically and electronically tuned Gunn-effect oscillators in the 10.5GHz band. The high Q cavity offers frequency stability compatible with application as the transmitter (CL8640T) and receiver local oscillator (CL8640R) in short range data link systems.

QUICK REFERENCE DATA

| | CL8640R | CL8640T | |
|--|---------|---------|-----|
| Centre frequency | 10.49 | 10.56 | GHz |
| Mechanical tuning range min. | 120 | 120 | MHz |
| Electronic tuning range min. | 30 | 8.0 | MHz |
| Power output typ. | 6.0 | 6.0 | mW |
| Operating voltage | -7.0 | -7.0 | V |
| Output via square plain flange WG. 16, WR 90. 5985-99-083-0052 | | | |

CL8640R - receiver local oscillator

CL8640T - transmitter



Mullard

TYPICAL OPERATING CONDITIONS

| | | |
|---|----------------------|----|
| Supply voltage (note 1) | -7.0 | V |
| Starting current | 250 | mA |
| Running current | 170 | mA |
| Tuning voltage (modulation) (notes 1 and 2) | CL8640R -0.5 to -7.5 | V |
| | CL8640T -0.5 to -1.5 | V |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---------------------------------|-------|---------|
| Supply voltage max. | -7.2 | V |
| Supply voltage (transient) max. | -8.0 | V |
| Tuning voltage max. | -12 | V |
| Tuning current max. | 100 | μ A |
| Load v.s.w.r. max. | 1.5:1 | |

CHARACTERISTICS (at 25°C)

| | | | | | |
|-----------------------------------|---------|------|-------|-------|--------|
| Centre frequency | CL8640R | | | 10.49 | GHz |
| | CL8640T | | | 10.56 | GHz |
| | | Min. | Typ. | Max. | |
| Mechanical tuning range | | ±60 | - | - | MHz |
| Electronic tuning range | CL8640R | ±15 | - | - | MHz |
| (notes 2 and 3) | CL8640T | ±4.0 | - | - | MHz |
| Power output at -7.0V | | 4.0 | 6.0 | - | mW |
| Frequency pushing | | - | 3.0 | - | MHz/V |
| Frequency pulling (note 4) | | - | 1.5 | - | MHz |
| Frequency temperature coefficient | | - | -0.25 | -0.3 | MHz/°C |
| Tuning current | | - | - | 10 | µA |

TEMPERATURE

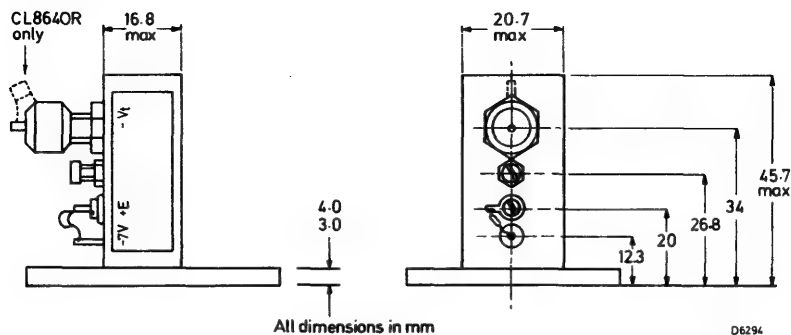
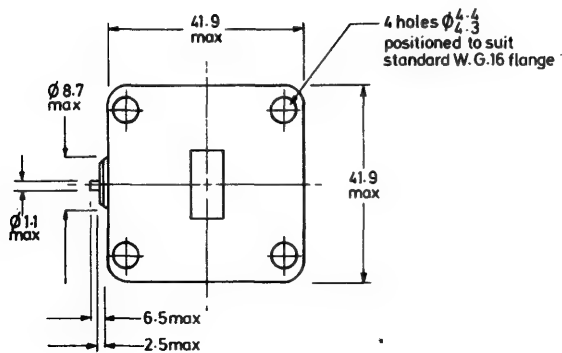
| | | | |
|-----------------|-------------|-------------|----|
| | CL8640R | CL8640T | |
| Operating range | -15 to +70 | +25 to +70 | °C |
| Storage range | -30 to +100 | -30 to +100 | °C |

OPERATING NOTES

1. The active element will be damaged if the supply voltage is reversed. Care should be taken to avoid transients in the supply voltage.
2. The electronic tuning provided by the varactor diode circuit is non-linear, following an approximately exponential rate of change of capacitance at low tuning voltages.
3. For CL8640R the tuning voltage range is -0.5V to -7.5V with the electronic centre at -2.5V.
4. V.S.W.R. = 1.5:1

**X-BAND GUNN
OSCILLATOR**

**CL8640R
CL8640T**



OUTLINE DRAWING

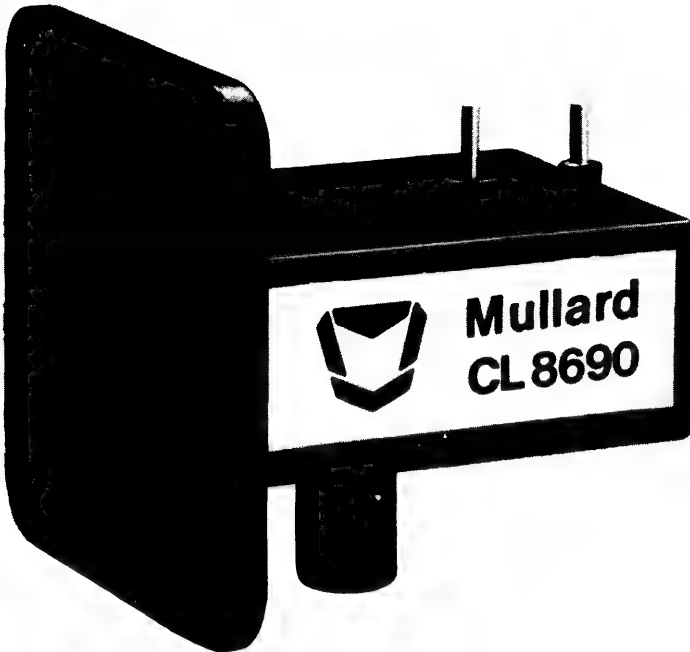
Mullard

X-BAND GUNN OSCILLATOR

This is an electronically and mechanically tuned oscillator suitable for use as a solid state replacement for reflex klystrons. It may be used as a local oscillator in marine radar systems. The device has been tested to ensure its compliance with the requirements of Board of Trade specification BOT SBN 115 10057/1.

QUICK REFERENCE DATA

| | | | |
|-------------------------|------|----------|-----|
| Output connector | | WG16 | |
| Centre frequency | | 9.375 | GHz |
| Mechanical tuning range | min. | ± 75 | MHz |
| Electronic tuning range | min. | ± 25 | MHz |
| Power output | min. | 5 | mW |
| Operating voltage | | -7.5 | V |



TYPICAL OPERATING CONDITIONS

| | | |
|--------------------------------|-----------|---------|
| Supply voltage (note 1) | -7.5 | V |
| Supply current | 160 | mA |
| Tuning voltage (notes 1 and 2) | -1 to -12 | V |
| Tuning current | 10 | μ A |

LIMITING VALUES at 20 °C

In accordance with the Absolute Maximum System

| | | | |
|-------------------------------|------|------------|---------|
| Supply voltage | max. | -8 | V |
| Supply current (note 3) | max. | 200 | mA |
| Tuning voltage | max. | -15 | V |
| Tuning current | max. | 100 | μ A |
| Storage temperature | | -45 to +85 | °C |
| Ambient operating temperature | | -15 to +50 | °C |

CHARACTERISTICS at 20 °C

| | | | | |
|--|----------|-----------|----------|----------|
| Centre frequency (note 4) | | | 9.375 | GHz |
| | min. | typ. | max. | |
| Mechanical tuning range | ± 75 | ± 100 | | MHz |
| Electronic tuning range | ± 25 | ± 30 | | MHz |
| Power output (note 5) | 5 | 8 | | mW |
| Frequency deviation over temperature range | | ± 15 | ± 25 | MHz |
| Frequency pushing | | 10 | 15 | MHz/V |
| Frequency pulling (note 6) | | | 20 | MHz |
| Mechanical tuning rate | | | 250 | MHz/turn |

Notes

1. The active element will be damaged if the supply voltage is reversed. In addition, care should be taken to avoid transients in the supply voltage as far as possible.
2. The tuning voltage should have a source impedance of less than 1 k Ω .
3. During the switch-on period, the Gunn device current will rise to a peak of up to 300 mA at approximately -4 V and then fall to the specified operating current at -7.5 V.
4. The centre frequency is measured with supply voltages of -7.5 V to the Gunn device and -5 V to the varactor diode.
5. Power output is measured under all conditions of tuning and temperature.
6. The load v.s.w.r. is 1.3 max. Frequency pulling is measured over all phases of mismatch.

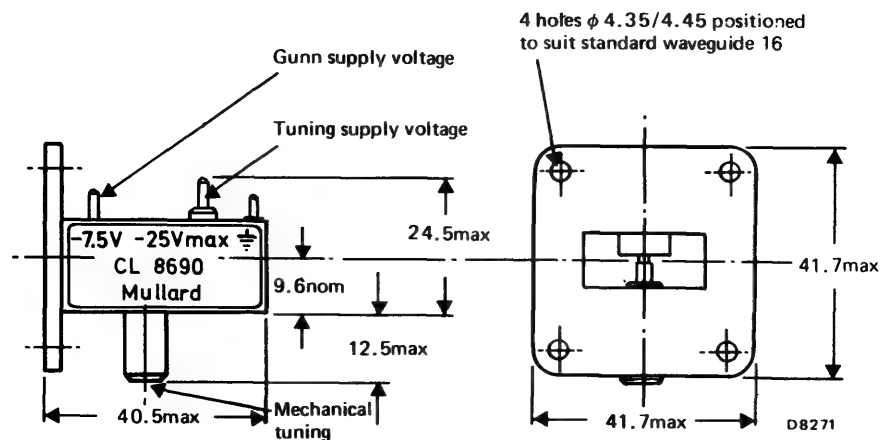
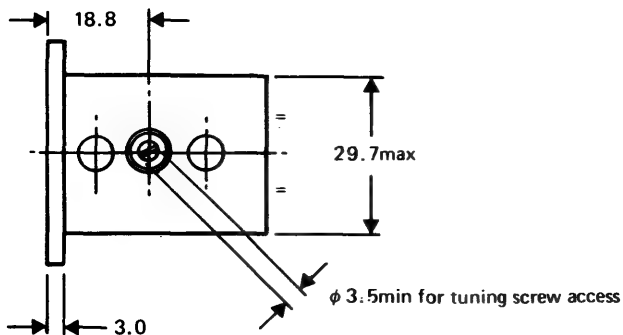


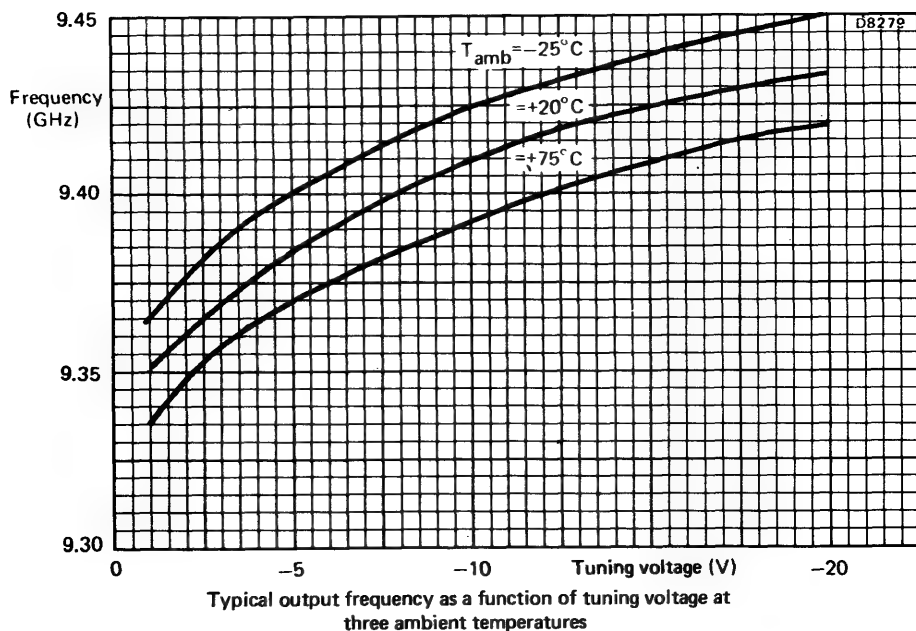
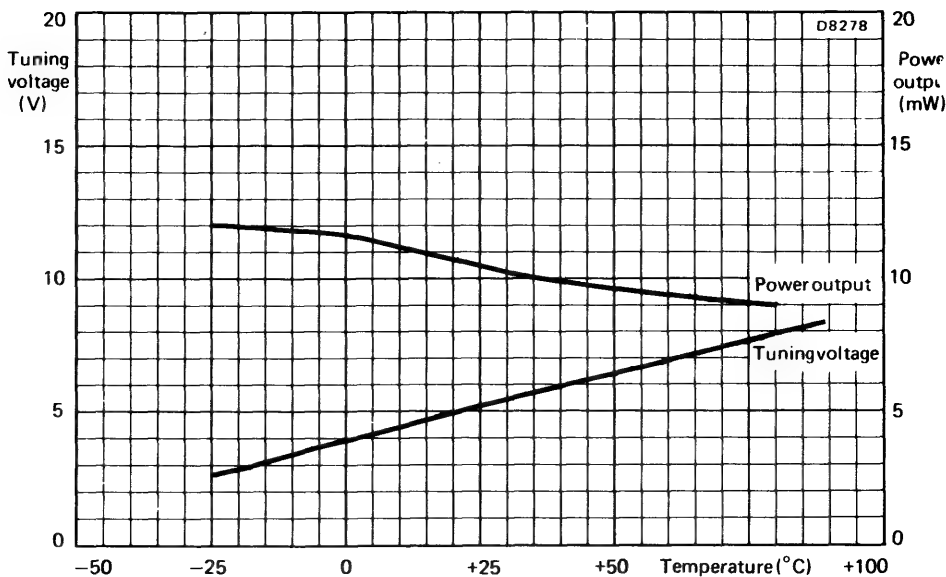
APPLICATION NOTES

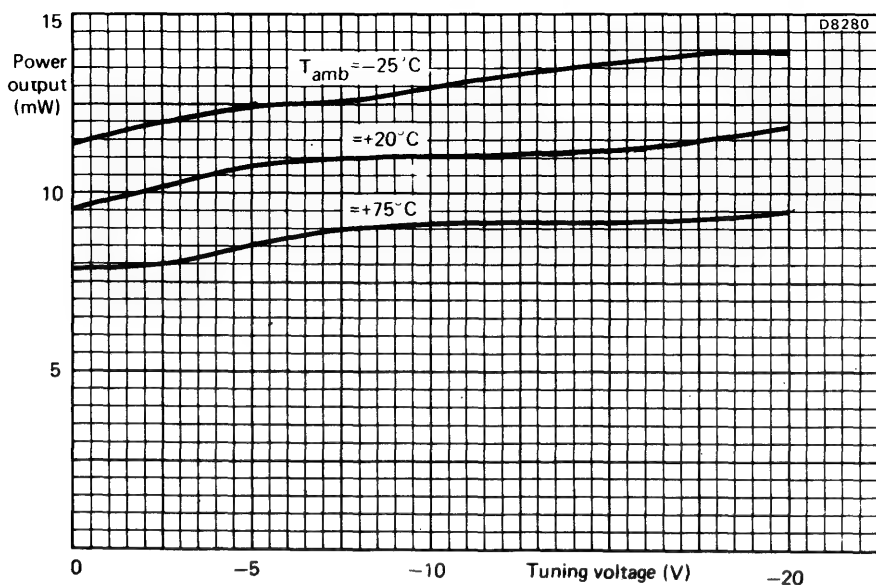
1. Three solder pins are provided for connection of the supply voltages and the earth contact.
2. To prevent parasitic low frequency oscillation, a $1\ \mu\text{F}$ capacitor is connected across the Gunn device.
3. The centre frequency may be set within the limits given in the characteristics, by turning the screw.
4. A zener diode should be connected across the Gunn device supply for transient protection.

MECHANICAL DATA

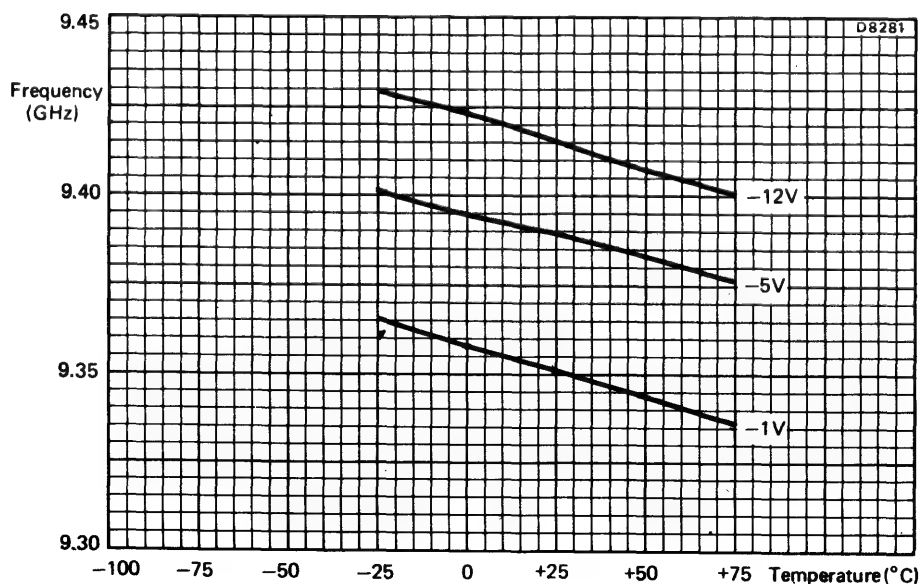
Dimensions in mm





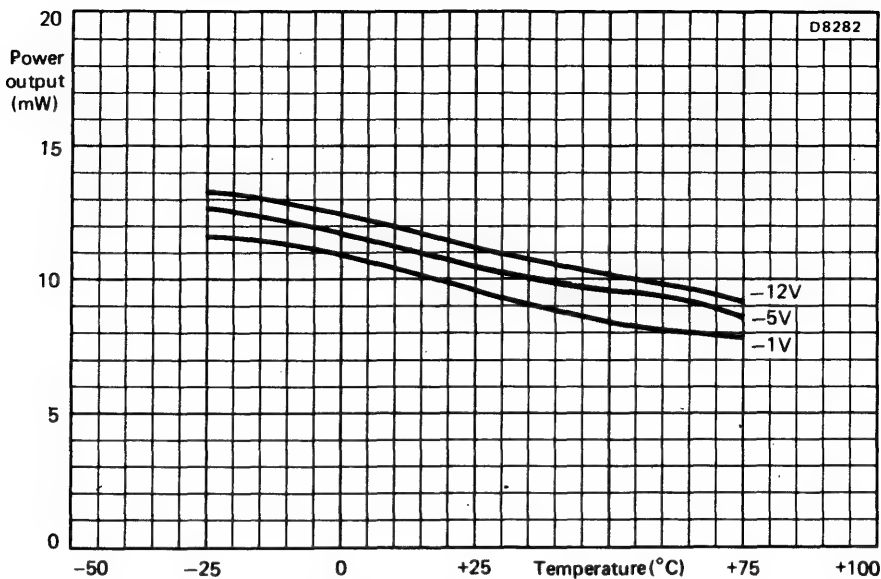


Typical power output as a function of tuning voltage at three ambient temperatures



Typical output frequency as a function of temperature at three tuning voltages.



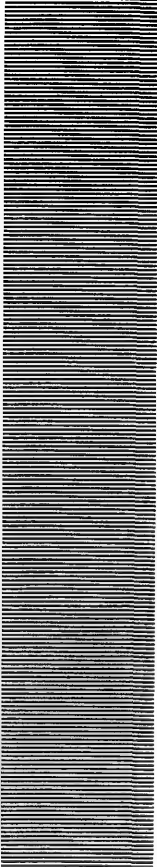


Typical power output as a function of temperature at
three tuning voltages



DOPPLER AND TRAFFIC RADARS

G



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X-BAND TRAFFIC RADAR SENSOR

Fixed frequency radar traffic sensor, with direction sense, for operation in the 10.6 GHz band. The sensor uses Doppler radar to provide vehicle actuation for permanent or portable traffic light signals. It complies with national government regulations (in the U.K. D. o.E. specifications MCE0111, MCE0114 and MCG0500 and Home Office regulation BR14, 1975 specification).

QUICK REFERENCE DATA

| | |
|---|------------|
| Centre frequency | 10.587 GHz |
| Transmitted power | typ. 5 mW |
| Detection range for small vehicle moving at 30 m.p.h. with sensor mounted 2.5 m above typical road surface | 100 m |
| Supply voltage (a.c.) | 110 V |



OPERATING CONDITIONSSupply voltage (110 V_{ac} centre-tapped)

55—0—55 V

Power consumption

typ. 7 W

LIMITING VALUES

In accordance with the Absolute Maximum System

Supply voltage (a.c.)

55—0—55±20% V

Storage temperature

— 20 to + 70 °C

Ambient operating temperature

— 15 to + 50 °C

CHARACTERISTICS

Centre frequency

min. typ. max.

fixed in the range

10.577 10.587 10.597 GHz

Transmitted power

— 5 10 mW

Detection range for vehicle moving
at 30 m.p.h. with sensor mounted
2.5 m above typical road surface

85 100 140 m

Mass

3 kg

CABLE ENTRY

At bottom rear of sensor



OPERATING NOTES

- 1. The sensor is of single-chassis construction.
- 2. It is recommended that the sensor is mounted so that the centre of the microwave window (radome) is not less than 150 mm above the cowl of the red signal. There will then be minimal interruption of the beam by the cowl and the near-field performance of the sensor will not be impaired.
- 3. In operation, the traffic signal controller demand input is connected to the 'relay output' terminals. In the standard unit for use with portable signal heads, the relay is energized closed, except when a demand is present.
- 4. Units with 'normally open' relay connections are available on request.
- 5. A 47 Ω resistor in series with the relay output terminals is included for overcurrent and overvoltage protection.
- 6. Upon detection of oncoming traffic, the relay in the sensor is de-energized and a pair of isolated contacts is opened to signify detection.
- 7. These contacts remain open during the detection of a stream of oncoming traffic. The minimum open time is nominally 1 second.
- 8. Signals caused by departing vehicles are ignored.
- 9. Should a fault occur in the sensor, or its supply voltage be interrupted, then the sensor relay will be permanently de-energized and a continuous demand will be applied to the controller. The traffic signals will then operate automatically in a fixed-time manner.
- 10. The power supply for the sensor is derived from the main traffic control unit; a 55–0–55 V centre-tapped a.c. supply is necessary.
- 11. The cable colour code shown in table 1 must be observed.

| TABLE 1 | |
|-------------------|--|
| Cable colour code | |
| Red | 55 V _{ac} |
| Orange | 55 V _{ac} |
| Black | 0 V (centre tap of 110 V a.c. supply) |
| Green/Yellow | Normally closed output contacts (isolated) |
| Green | |

- 12. The equipment detects lone vehicles approaching the traffic signals in the presence of large departing vehicles or a heavy stream of departing traffic. This is an important feature of the design philosophy of the radar process circuit.
- 13. The equipment does not give false outputs in the absence of moving targets.
- 14. Signals reflected from fluttering or waving trees at reasonable distances from the sensor do not cause unwanted outputs, even if the sensor is aimed directly at the trees.
- 15. For temporary traffic light systems, a 'NUDGE' facility is included.
- 16. The NUDGE facility is such that in the absence of a demand from approaching traffic for a period of 2½ minutes, a 'phantom' demand is applied. The relay in the sensor is de-energized and the sensor then returns to the vehicle-actuated mode. The period is set by a digital timer which is independent of the ambient temperature.



OPERATING NOTES (continued)

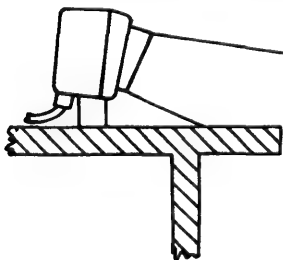
17. The 'phantom' demand overcomes the rare lock-up situations in traffic flow at temporary traffic lights where the possibility of a permanent 'red-red' can occur, caused by the non-detection of approaching vehicles.

SITE TESTS

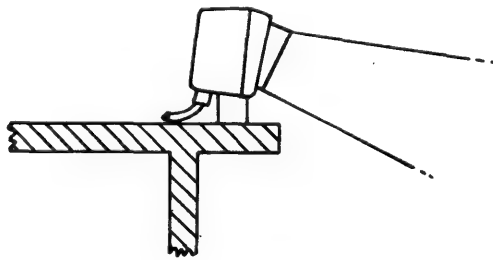
1. To check the operation of a sensor, set it up in the operating position with the power supplies connected and connect a multimeter such as the AVO Model 8, switched to a resistance-measuring range, across the normally-closed contacts. (Note: high-voltage circuit testers, such as the Megger, must not be used as they will damage the sensor). The measured resistance should be approximately $47\ \Omega$; this is the value of the protection resistor incorporated in the circuit.
2. Check the a.c. supply voltages at the microwave head. The line-to-line voltage should be $110\ V_{rms}$ and the voltage between each line and the 0 V terminal should be $55\ V_{rms}$. The tolerance on these voltages is $\pm 20\%$.
3. Arrange for a vehicle, preferably a small car, to be driven towards and past the sensor at approximately 30 m.p.h. When the car is between 140 and 80 metres from the sensor (see fig.2), the measured resistance between the normally-closed contacts should quickly increase to indicate an open-circuit. This condition should continue for approximately 1 second after the car has passed out of the sensor's detection range.

WORKSHOP TESTS FOR INOPERATIVE SENSORS

1. These tests are intended to reveal inoperative sensors only. It must be noted that they do not replace any range tests carried out with a vehicle under site conditions. There is no attempt to correlate range measurements with these tests as they will only inform the operator that a sensor is functioning correctly, not functioning or is functioning in reverse. They will, however, ensure that there is some consistency of testing between different operators.
2. Ideally, the sensor should be sited in an environment free, as far as possible, from extraneous movements of large bodies such as people, fork lift trucks, etc.
3. The sensor should be placed on a level surface, e.g. a bench, as near to the edge as possible to avoid reflections from the bench surface.



Incorrect



Correct

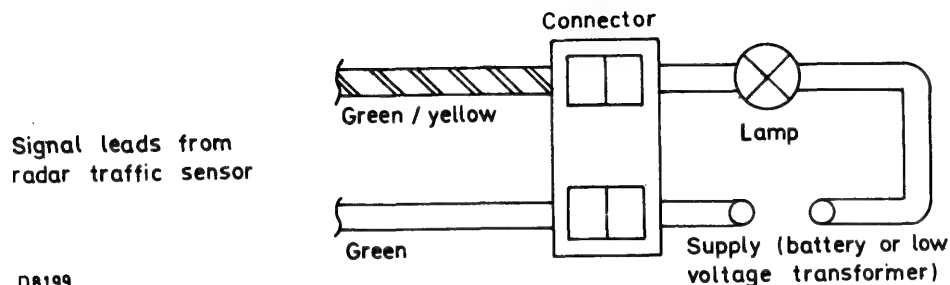
D8198

It should not be pointed directly at fluorescent lights as they may cause false demands to be registered due to interference.

4. Ensure that the environment is free as far as possible from microwave interference, for example, radar traffic sensors on soak test in the vicinity of the beam could cause interference giving rise to false demands.



5. The supply cable should be connected in accordance with the coding given in table 1 on page 3.
6. Demands may be observed by connecting the signal output leads (green and green/yellow) to a controller with a lamp which indicates presence of a demand. Alternatively, a bulb and power supply may be connected in series with the signal leads via a simple connector block such as the push-button type 'quick connector' available from Radiospares. See diagram below



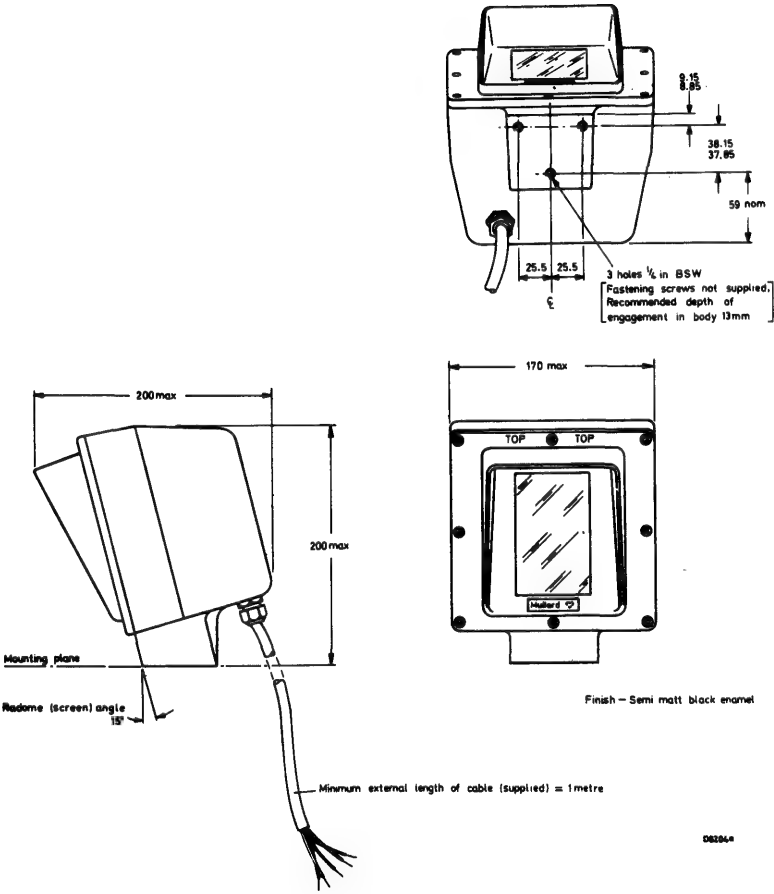
D8199

This simple method will eliminate the possibility of controller faults.

7. With the supply connected and switched on, the indicator lamp should be illuminated.
8. A demand will be indicated when the lamp is extinguished.
9. Leave the sensor pointing into free space and check for false demands. The lamp should remain alight for approximately 2 to 2½ minutes until the 'nudge' circuitry puts in a 'phantom' demand. These 'nudge' demands will reappear at regular intervals of 2 to 2½ minutes; no other demands should occur between them.
10. With the sensor placed on a level surface, (see note 3), about 1½ metres from ground level, the operator should stand about 5 metres away from the sensor in a direct line with the microwave window (radome) and should have the demand indicator lamp in view. He should then walk at normal walking pace towards the sensor, stopping at about 1 metre from it. If the sensor is functioning correctly, a demand will be registered between starting to walk and stopping. He should then wait for the demand to clear and then walk backwards to his starting point. No demand should be registered. If a demand is observed, the sensor is working in reverse and is therefore faulty.

MECHANICAL DATA

Dimensions in mm



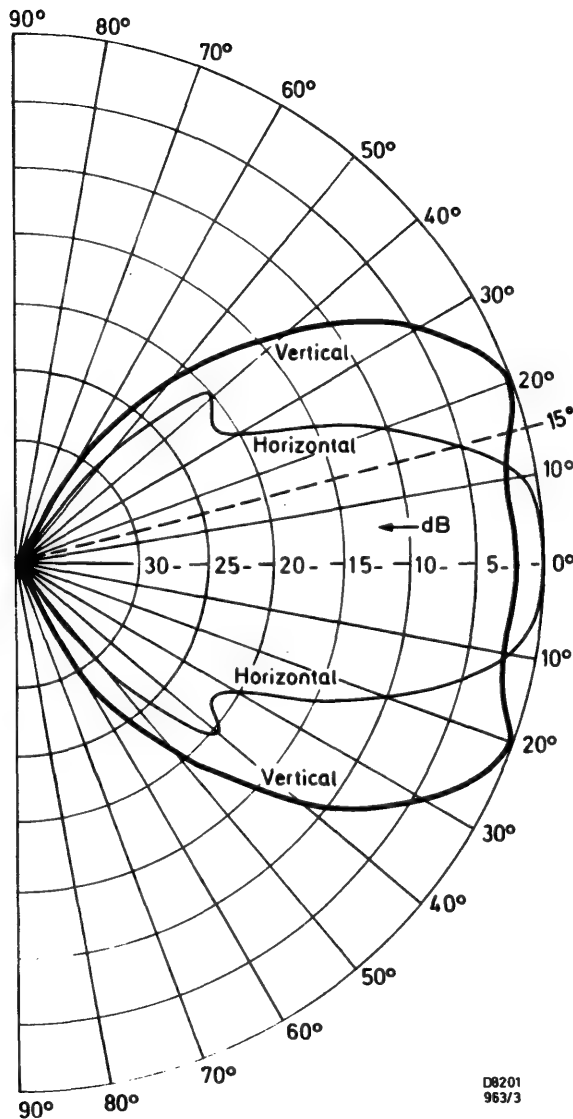


Fig.1 Typical polar diagram of traffic radar sensor.
The broken line indicates the preferred mounting angle of 15°. This affects only the orientation of the vertical pattern



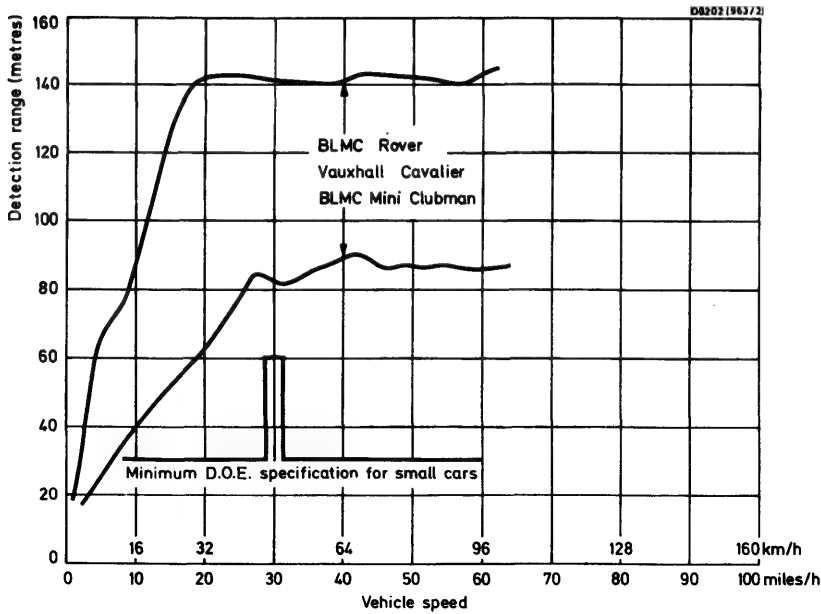


Fig.2 Detection curves obtained from road tests using six different traffic radar sensors

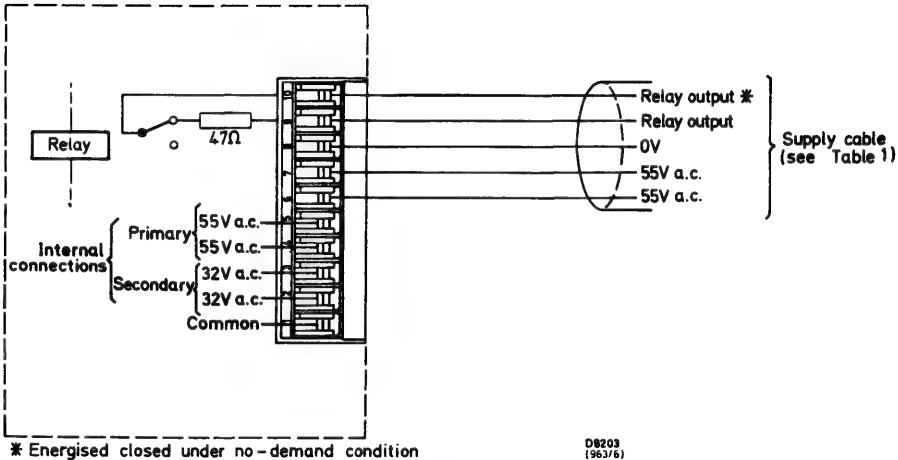


Fig.3 Terminal block connections. The two 55 V terminals on the supply cable are of opposite phase and are part of a 55–0–55 V a.c. supply.



QUALITY APPROVAL OF TRAFFIC RADAR SENSORS

The sensors are currently produced at the Mullard plant at Hazelgrove, Cheshire. The Quality Department within Mullard Hazelgrove operates to standards set by BS9000 and is supported by a resident E.Q.D. inspector. Product developments are steered through a rigorous release procedure; development sample are appraised before approval for production.

In the case of these radar sensors, the individual semiconductor diodes are the subject of a separate quality release exercise, in addition to that carried out on the final sensor. In production, the semiconductor diodes are batch-approved by the Quality Department before assembly.

Quality control procedures for production include:

1. Raw material inspection.
2. Quality control within the assembly areas.
3. 100% electrical testing of primary parameters and sample testing to appropriate A.Q.L.
4. Environmental sample testing.
5. Measurement of secondary electrical parameters on batch samples.
6. Calibration and standardization of test procedures.

Where customer requirements differ from the standard commercial product, liaison is established with specific customers and suitable procurement specifications are agreed.



X-BAND TRAFFIC RADAR SENSOR

Fixed frequency radar traffic sensor, with direction sense, for operation in the 10.6 GHz band. The sensor uses Doppler radar to provide vehicle actuation for permanent or portable traffic light signals. It complies with national government regulations (in the U.K. D.o.E. specifications MCE0111, MCE0114 and MCG0500 and Home Office regulation BR14, 1975 specification).

QUICK REFERENCE DATA

| | |
|---|------------|
| Centre frequency | 10.587 GHz |
| Transmitted power | typ. 5 mW |
| Detection range for small vehicle moving at 30 m.p.h. with sensor mounted 2.5 m above typical road surface | 100 m |
| Supply voltage (a.c.) | 110 V |



OPERATING CONDITIONS

| | |
|--|-----------|
| Supply voltage (110 V _{ac} centre-tapped) | 55—0—55 V |
| Power consumption | typ. 7 W |

LIMITING VALUES

In accordance with the Absolute Maximum System

| | |
|-------------------------------|-----------------|
| Supply voltage (a.c.) | 55—0—55±20% V |
| Storage temperature | — 20 to + 70 °C |
| Ambient operating temperature | — 15 to + 50 °C |

CHARACTERISTICS

| | min. | typ. | max. | |
|--|--------|--------|--------|-----|
| Centre frequency fixed in the range | 10.577 | 10.587 | 10.597 | GHz |
| Transmitted power | — | 5 | 10 | mW |
| Detection range for vehicle moving at 30 m.p.h. with sensor mounted 2.5 m above typical road surface | 85 | 100 | 140 | m |
| Mass | | 3 | | kg |

CABLE ENTRY

Through the mounting foot



OPERATING NOTES

1. The sensor is of single-chassis construction.
2. It is recommended that the sensor is mounted so that the centre of the microwave window (radome) is not less than 150 mm above the cowl of the red signal. There will then be minimal interruption of the beam by the cowl and the near-field performance of the sensor will not be impaired.
3. In operation, the traffic signal controller demand input is connected to the 'relay output' terminals. In the standard unit for use with portable signal heads, the relay is energized closed, except when a demand is present.
4. Units with 'normally open' relay connections are available on request.
5. A $47\ \Omega$ resistor in series with the relay output terminals is included for overcurrent and overvoltage protection.
6. Upon detection of oncoming traffic, the relay in the sensor is de-energized and a pair of isolated contacts is opened to signify detection.
7. These contacts remain open during the detection of a stream of oncoming traffic. The minimum open time is nominally 1 second.
8. Signals caused by departing vehicles are ignored.
9. Should a fault occur in the sensor, or its supply voltage be interrupted, then the sensor relay will be permanently de-energized and a continuous demand will be applied to the controller. The traffic signals will then operate automatically in a fixed-time manner.
10. The power supply for the sensor is derived from the main traffic control unit; a 55–0–55 V centre-tapped a.c. supply is necessary.
11. The cable colour code shown in table 1 must be observed.

| TABLE 1 Cable colour code | |
|------------------------------|--|
| Red | 55 V _{ac} |
| Orange | 55 V _{ac} |
| Black | 0 V (centre tap of 110 V a.c. supply) |
| Green/Yellow | Normally closed output contacts (isolated) |
| Green | |

12. The equipment detects lone vehicles approaching the traffic signals in the presence of large departing vehicles or a heavy stream of departing traffic. This is an important feature of the design philosophy of the radar process circuit.
13. The equipment does not give false outputs in the absence of moving targets.
14. Signals reflected from fluttering or waving trees at reasonable distances from the sensor do not cause unwanted outputs, even if the sensor is aimed directly at the trees.
15. For temporary traffic light systems, a 'NUDGE' facility is included.
16. The NUDGE facility is such that in the absence of a demand from approaching traffic for a period of 2½ minutes, a 'phantom' demand is applied. The relay in the sensor is de-energized and the sensor then returns to the vehicle-actuated mode. The period is set by a digital timer which is independent of the ambient temperature.



OPERATING NOTES (continued)

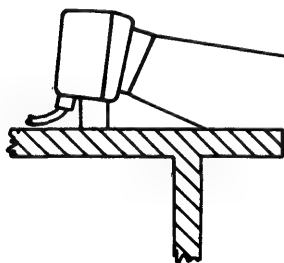
17. The 'phantom' demand overcomes the rare lock-up situations in traffic flow at temporary traffic lights where the possibility of a permanent 'red-red' can occur, caused by the non-detection of approaching vehicles.

SITE TESTS

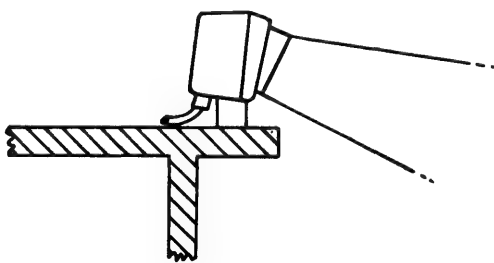
1. To check the operation of a sensor, set it up in the operating position with the power supplies connected and connect a multimeter such as the AVO Model 8, switched to a resistance-measuring range, across the normally-closed contacts. (Note: high-voltage circuit testers, such as the Megger, must not be used as they will damage the sensor). The measured resistance should be approximately $47\ \Omega$; this is the value of the protection resistor incorporated in the circuit.
2. Check the a.c. supply voltages at the microwave head. The line-to-line voltage should be $110\ V_{rms}$ and the voltage between each line and the 0 V terminal should be $55\ V_{rms}$. The tolerance on these voltages is $\pm 20\%$.
3. Arrange for a vehicle, preferably a small car, to be driven towards and past the sensor at approximately 30 m.p.h. When the car is between 140 and 80 metres from the sensor (see fig.2), the measured resistance between the normally-closed contacts should quickly increase to indicate an open-circuit. This condition should continue for approximately 1 second after the car has passed out of the sensor's detection range.

WORKSHOP TESTS FOR INOPERATIVE SENSORS

1. These tests are intended to reveal inoperative sensors only. It must be noted that they do not replace any range tests carried out with a vehicle under site conditions. There is no attempt to correlate range measurements with these tests as they will only inform the operator that a sensor is functioning correctly, not functioning or is functioning in reverse. They will, however, ensure that there is some consistency of testing between different operators.
2. Ideally, the sensor should be sited in an environment free, as far as possible, from extraneous movements of large bodies such as people, fork lift trucks, etc.
3. The sensor should be placed on a level surface, e.g. a bench, as near to the edge as possible to avoid reflections from the bench surface.



Incorrect



Correct

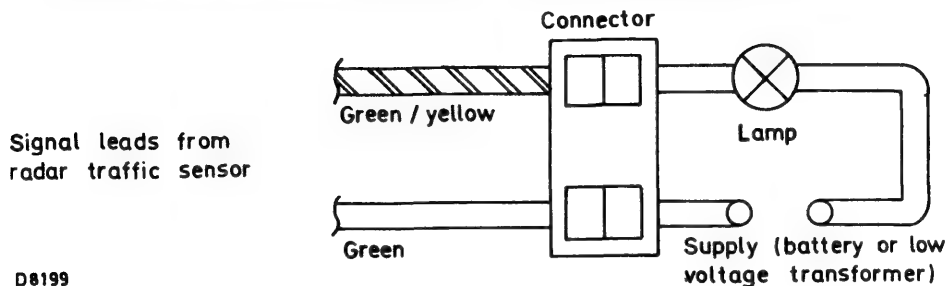
D8198

It should not be pointed directly at fluorescent lights as they may cause false demands to be registered due to interference.

4. Ensure that the environment is free as far as possible from microwave interference, for example, radar traffic sensors on soak test in the vicinity of the beam could cause interference giving rise to false demands.



5. The supply cable should be connected in accordance with the coding given in table 1 on page 3.
6. Demands may be observed by connecting the signal output leads (green and green/yellow) to a controller with a lamp which indicates presence of a demand. Alternatively, a bulb and power supply may be connected in series with the signal leads via a simple connector block such as the push-button type 'quick connector' available from Radiospares. See diagram below

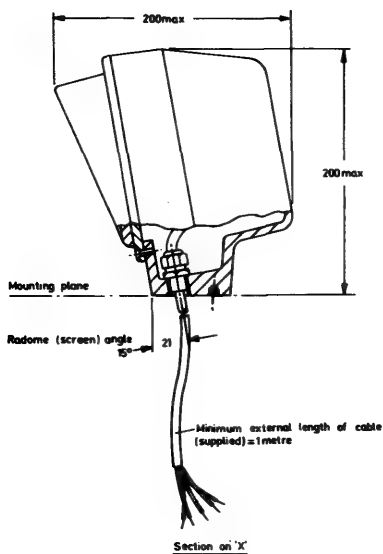


This simple method will eliminate the possibility of controller faults.

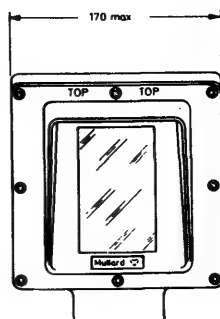
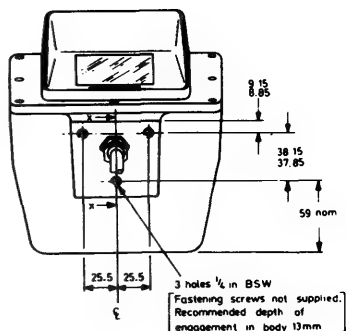
7. With the supply connected and switched on, the indicator lamp should be illuminated.
8. A demand will be indicated when the lamp is extinguished.
9. Leave the sensor pointing into free space and check for false demands. The lamp should remain alight for approximately 2 to 2½ minutes until the 'nudge' circuitry puts in a 'phantom' demand. These 'nudge' demands will reappear at regular intervals of 2 to 2½ minutes; no other demands should occur between them.
10. With the sensor placed on a level surface, (see note 3), about 1½ metres from ground level, the operator should stand about 5 metres away from the sensor in a direct line with the microwave window (radome) and should have the demand indicator lamp in view. He should then walk at normal walking pace towards the sensor, stopping at about 1 metre from it. If the sensor is functioning correctly, a demand will be registered between starting to walk and stopping. He should then wait for the demand to clear and then walk backwards to his starting point. No demand should be registered. If a demand is observed, the sensor is working in reverse and is therefore faulty.

MECHANICAL DATA

Dimensions in mm



Section on 'X'



D02950

Finish - Semi matt black enamel



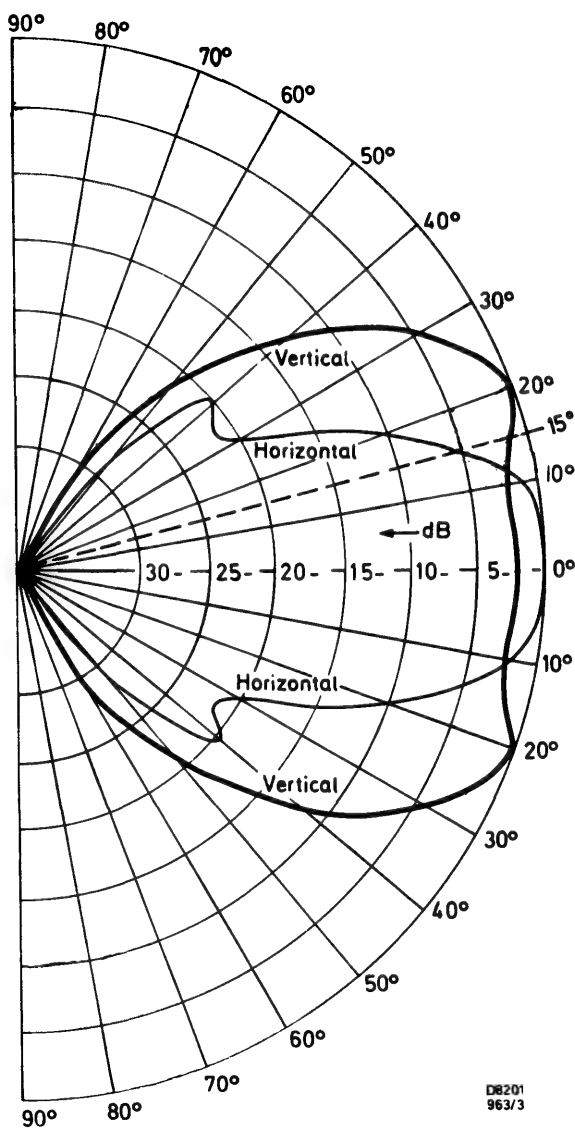


Fig. 1 Typical polar diagram of traffic radar sensor.
The broken line indicates the preferred mounting angle of 15°. This affects only the orientation of the vertical pattern.



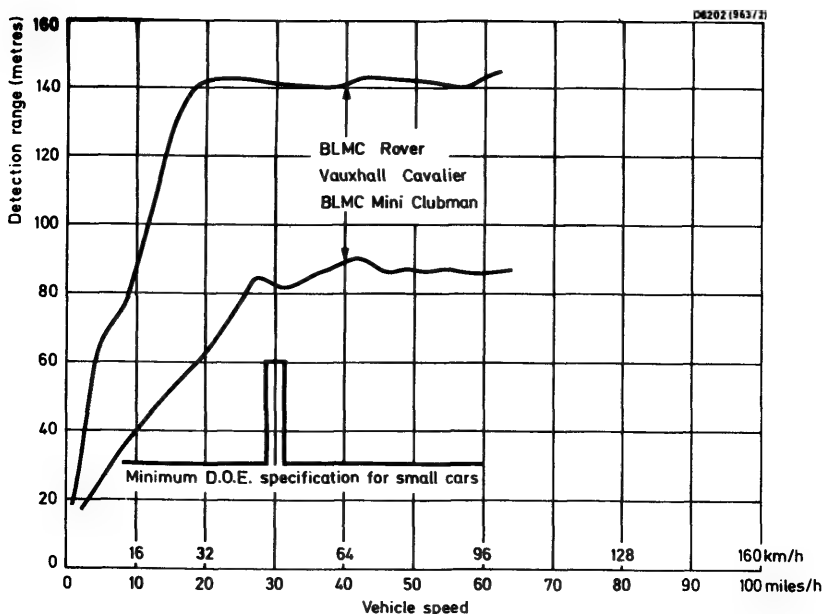


Fig.2 Detection curves obtained from road tests using six different traffic radar sensors

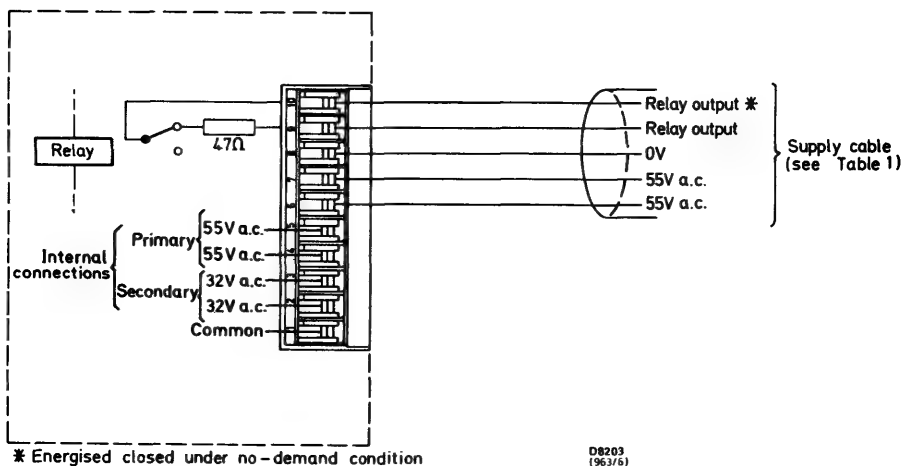


Fig.3 Terminal block connections. The two 55 V terminals on the supply cable are of opposite phase and are part of a 55-0-55 V a.c. supply.

QUALITY APPROVAL OF TRAFFIC RADAR SENSORS

The sensors are currently produced at the Mullard plant at Hazelgrove, Cheshire. The Quality Department within Mullard Hazelgrove operates to standards set by BS9000 and is supported by a resident E.Q.D. inspector. Product developments are steered through a rigorous release procedure; development sample are appraised before approval for production. In the case of these radar sensors, the individual semiconductor diodes are the subject of a separate quality release exercise, in addition to that carried out on the final sensor. In production, the semiconductor diodes are batch-approved by the Quality Department before assembly. Quality control procedures for production include:

1. Raw material inspection.
2. Quality control within the assembly areas.
3. 100% electrical testing of primary parameters and sample testing to appropriate A.Q.L.
4. Environmental sample testing.
5. Measurement of secondary electrical parameters on batch samples.
6. Calibration and standardization of test procedures.

Where customer requirements differ from the standard commercial product, liaison is established with specific customers and suitable procurement specifications are agreed.



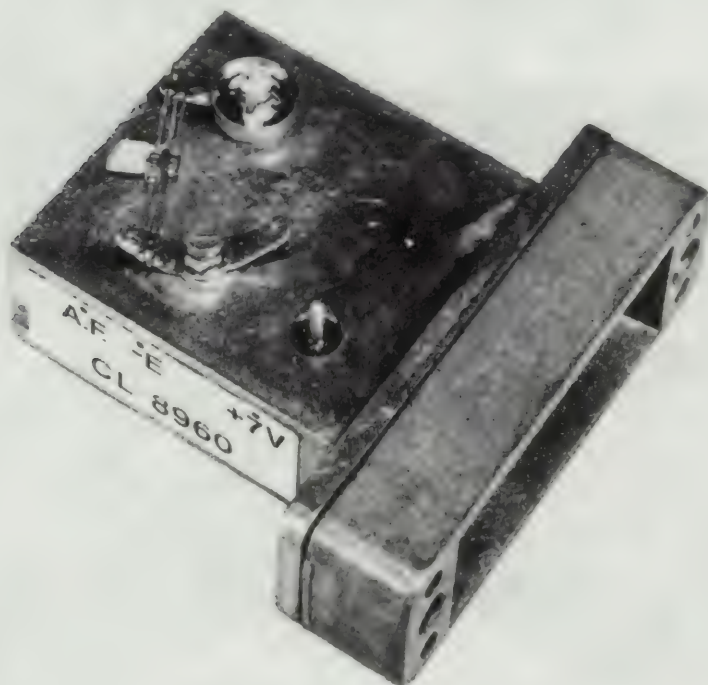
X-BAND DOPPLER RADAR MODULE

CL8960

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.7GHz band. Applications include all forms of Doppler radar systems.

| | | |
|---|--------|---------------|
| Centre frequency | 10.687 | GHz |
| Power output (at 7.0V) typ. | 10 | mW |
| Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$ | | |
| (see page 6 and note 1) | 40 | μV |
| Supply voltage | 7.0 | V |



Mullard

OPERATING CONDITIONS

| | | |
|---|----------------|------------|
| Supply voltage (see note 2) | +7.0 \pm 0.1 | V |
| Supply current (see note 3) (typ.) | 140 | mA |
| D. C. mixer bias current (into a. f. terminal w. r. t. earth) | 30 to 35 | μ A |
| A. F. load (see page 5) | 10 | k Ω |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|------------|--------------|
| Supply voltage (max. d. c.) | +7.5 | V |
| Supply voltage transient max. (1.0ms max.) | 9.0 | V |
| T _{stg} range | -10 to +70 | $^{\circ}$ C |
| T _{amb} range | 0 to +40 | $^{\circ}$ C |

CHARACTERISTICS at 25 $^{\circ}$ C

| | Min. | Typ. | Max. | |
|---|--------|------------|--------|-------------------|
| Centre frequency | - | | - | GHz |
| Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$) (see notes 1 and 4 and page 6) | 20 | 40 | - | μ V |
| Output power at 7.0V | - | 10 | - | mW |
| Frequency fixed | 10.675 | 10.687 | 10.699 | GHz |
| Frequency temperature coefficient | - | -0.2 | -0.3 | MHz/ $^{\circ}$ C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| Second harmonic | - | -35 | - | dBm |
| Diode current (see note 3) | - | 130 | 165 | mA |
| Polar diagram | | see page 7 | | |
| MASS | | 170 | | g |

Alternative antennae and operating frequencies may be made to suit customers' specific requirements.

OPERATING NOTES



1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB typ.).

Extended range may be obtained for a reduced $\frac{\text{signal} + \text{noise}}{\text{noise}}$ and this may be

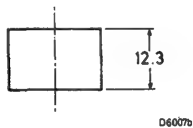
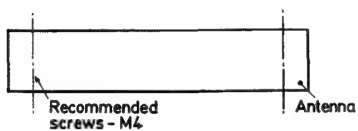
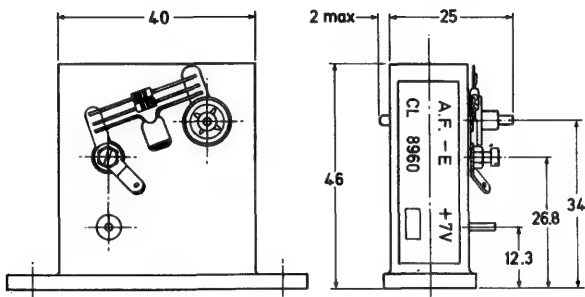
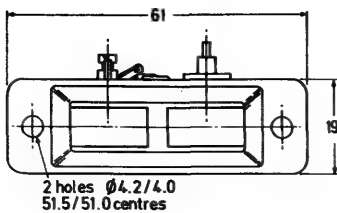
acceptable if the environment in which the system operates is stable, i.e., free from extraneous moving or vibrating objects. For example, 110dB path loss is obtained from a man target of radar cross-section 1.0m^2 at a range of 25m and the $\frac{\text{signal} + \text{noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of $16\mu\text{V}$ min.

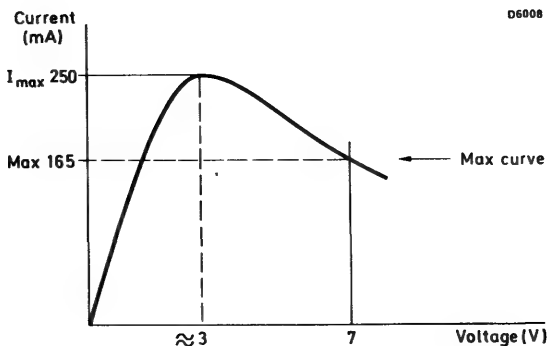
Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to Mullard Ltd.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.
3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.
4. Noise measured at a frequency 1Hz to 1kHz from carrier.
5. The Gunn device will be damaged if the supply is reversed.
6. The module is supplied with a protection circuit connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the protection circuit is not removed when all wiring has been completed.
7. Precautions similar to those required for CMOS devices are necessary, namely:
 - a) Earthed wrist straps should be worn.
 - b) Table tops or other working surfaces should be conductive and earthed.
 - c) Anti-static clothing should be worn.
 - d) No electrical testing should be carried out without specific, approved and written test procedures.
 - e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.
8. The above conditions apply when operated into the antenna supplied with the module.
9. A 10nF capacitor should be connected across and close to the +7V and earth terminals to suppress parasitic oscillations in the power supply.
10. $\frac{\text{Signal} + \text{noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

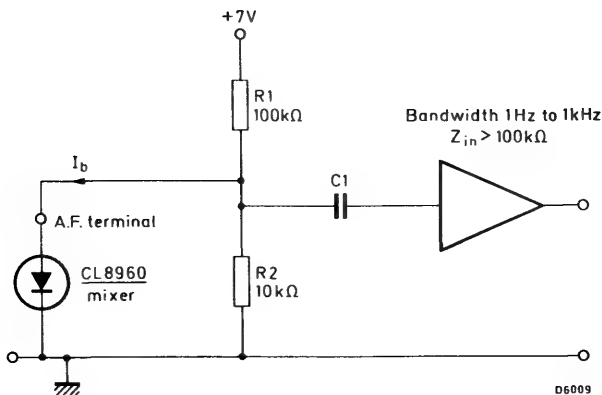


OUTLINE DRAWING





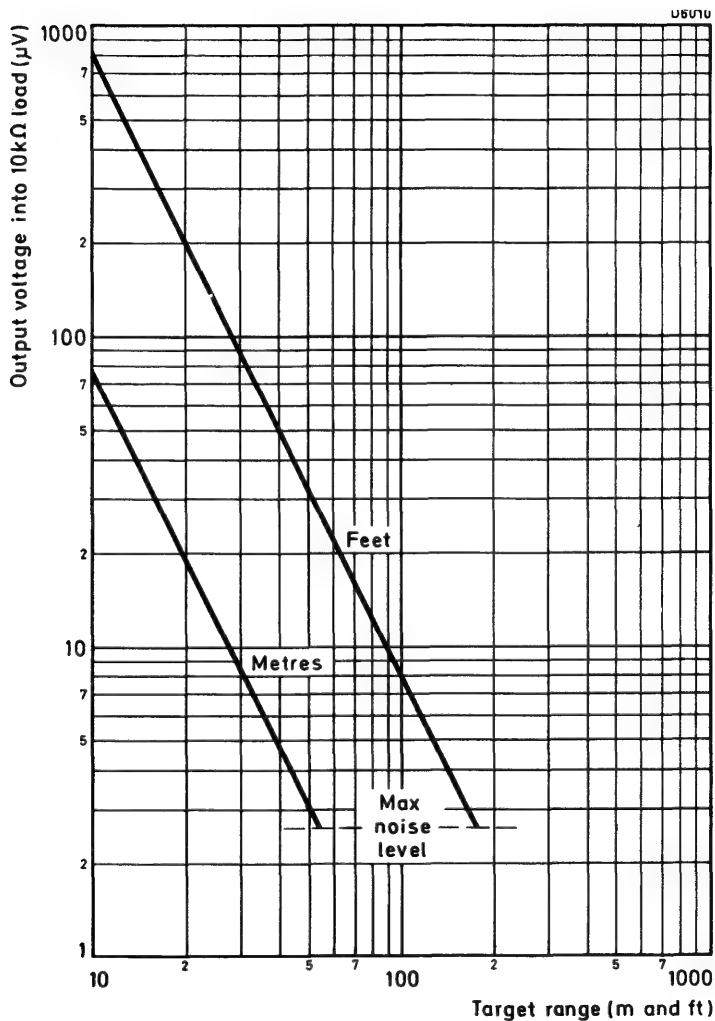
Gunn device characteristic



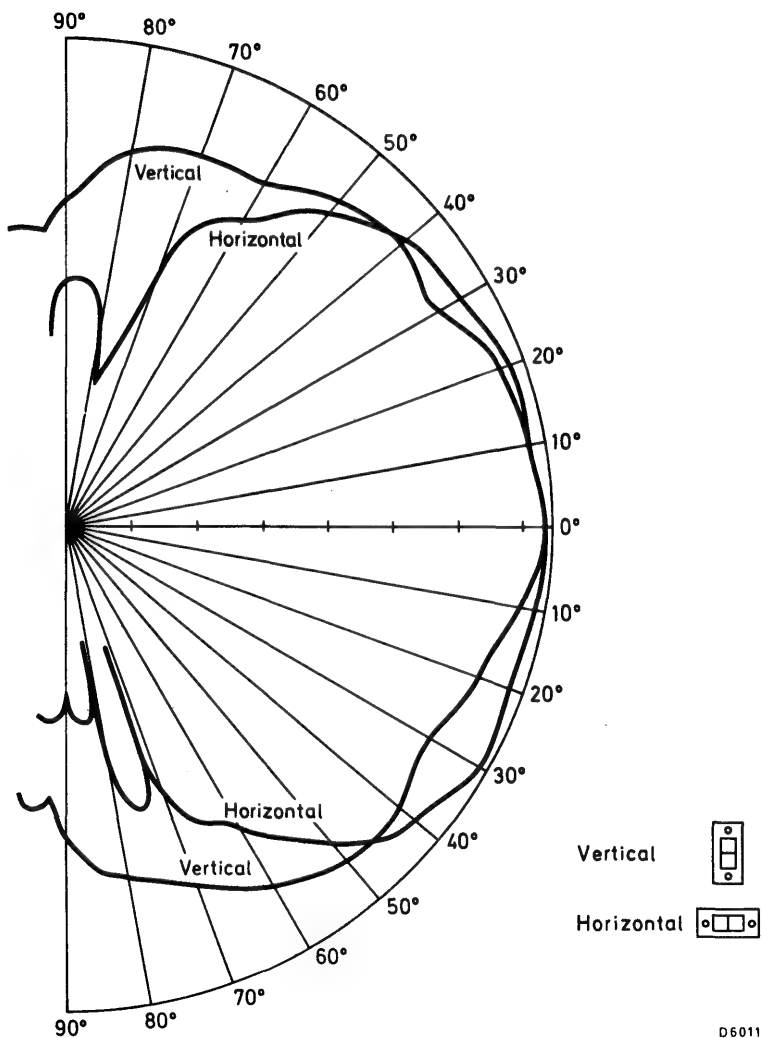
Circuit used to measure A. F. performance

Notes

1. The current I_b should be approximately $35\mu A$ with the Gunn device disconnected and approximately $42\mu A$ with the Gunn device operational and the antenna operating into free space.
2. The coupling capacitor should have a small impedance compared with Z_{in} .



Minimum output for a man target



Polar diagram for antenna supplied.

MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6mm thick metal plate with aperture dimensions as shown on page 9.

In this configuration, the metal plate forms the front panel of the equipment, and the antenna radiates into free space. If the equipment housing is all metal, any back radiation will be totally contained. Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.

The total mixer bias under the optimum operating conditions is approximately 42 μ A. (35 μ A d.c. bias + 7 μ A from -19dBm of coupled l.o. power.)

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

In this case, the l.o. power coupled to the mixer will be -11dBm, and the total mixer bias current will now be approximately 60 μ A.

The increase in l.o. power will, in general give rise to an increase in a.f. output voltage for a given target, but this will be accompanied by a degradation in signal to noise ratio. For -11dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.

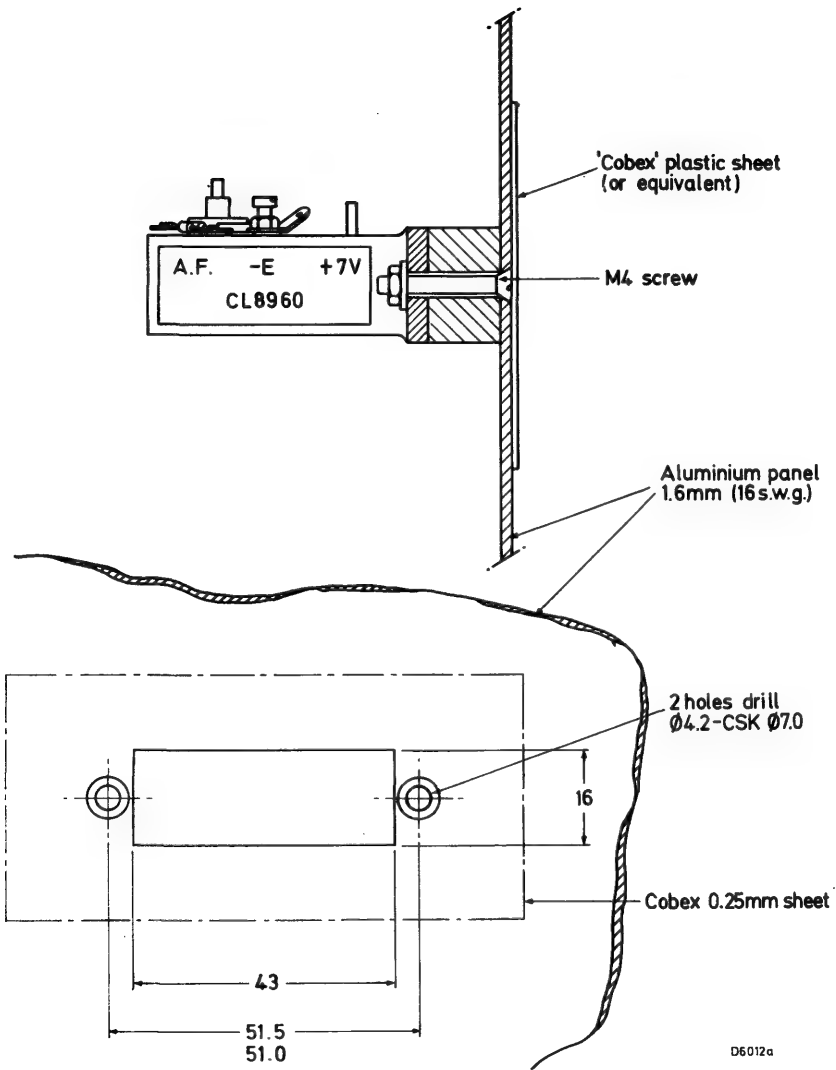
However, further increase in the level of coupled l.o. power arising from the use of thick or 'microwave' reflective covering materials, will:

- (a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.
- (b) present a mismatch to the Gunn oscillator which may impair the switching and running performance and may 'pull' the frequency outside the allocated operating frequency band.

The following table compares the l.o. coupling level obtained for different covering materials at the antenna.

| L. O. coupling (dBm) | Mixer total bias (μ A) | Antenna covering material |
|-------------------------|--------------------------------|--|
| - | 35 (d.c. only) | - |
| -19 | 42 | No covering |
| -15 | 50 | 1 to 2cm expanded polythene or polystyrene |
| -11 | 61 | 0.25mm Cobex plastic |
| -6 | 70 | 0.5mm Cobex plastic |

Cobex is a product of: British Industrial Plastics,
Sheet and Film Division,
Brantham Works,
Brantham,
Manningtree, Essex CO11 1NJ



Panel mounting details

X-BAND DOPPLER RADAR MODULE

CL8961

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 9.4 GHz band. Applications include all forms of Doppler radar systems.

| | | |
|--|-------|---------------|
| Centre frequency | 9.350 | GHz |
| Power output (at 7.0V) typ. | 10 | mW |
| Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$ (see page 6 and note 1) | 40 | μV |
| Supply voltage | 7.0 | V |



Mullard

OPERATING CONDITIONS

| | | |
|---|------------|----|
| Supply voltage (see note 2) | +7.0 ± 0.1 | V |
| Supply current (see note 3) (typ.) | 140 | mA |
| D. C. mixer bias current (into a. f. terminal w. r. t. earth) | 30 to 35 | μA |
| A. F. load (see page 5) | 10 | kΩ |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|------------|----|
| Supply voltage (max. d.c.) | +7.5 | V |
| Supply voltage transient max. (1.0ms max.) | 9.0 | V |
| T _{stg} range | -10 to +70 | °C |
| T _{amb} range | 0 to +40 | °C |

CHARACTERISTICS at 25 °C

| | Min. | Typ. | Max. | |
|---|------------|-------|-------|--------|
| Centre frequency | - | 9.350 | - | GHz |
| Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$) (see notes 1 and 4 and page 6) | 20 | 40 | - | μV |
| Output power at 7.0V | - | 10 | - | mW |
| Frequency fixed | 9.338 | 9.350 | 9.362 | GHz |
| Frequency temperature coefficient | - | -0.2 | -0.3 | MHz/°C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| Second harmonic | - | -35 | - | dBm |
| Diode current (see note 3) | - | 130 | 165 | mA |
| Polar diagram | see page 7 | | | |
| MASS | | 210 | | g |

Alternative antennae and operating frequencies may be made to suit customers' specific requirements.

OPERATING NOTES

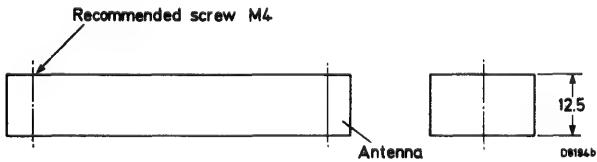
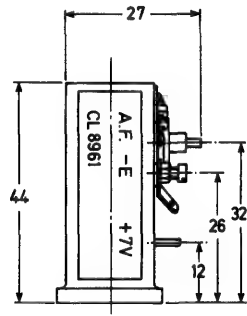
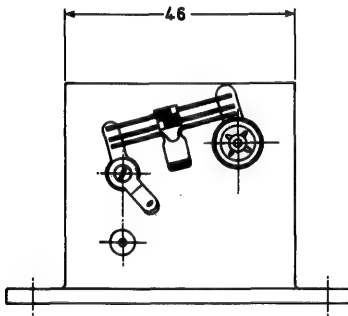
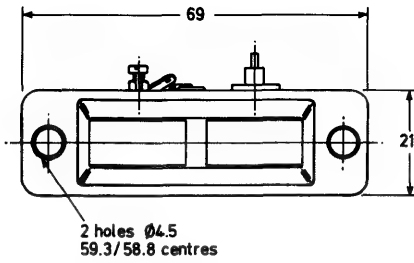
1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB typ.).

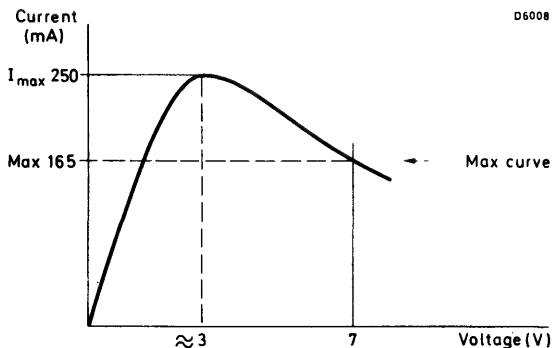
Extended range may be obtained for a reduced $\frac{\text{signal} + \text{noise}}{\text{noise}}$ and this may be acceptable if the environment in which the system operates is stable, i.e., free from extraneous moving or vibrating objects. For example, 110dB path loss is obtained from a man target of radar cross-section 1.0m^2 at a range of 25m and the $\frac{\text{signal} + \text{noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of $16\mu\text{V}$ min.

Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to Mullard Ltd.

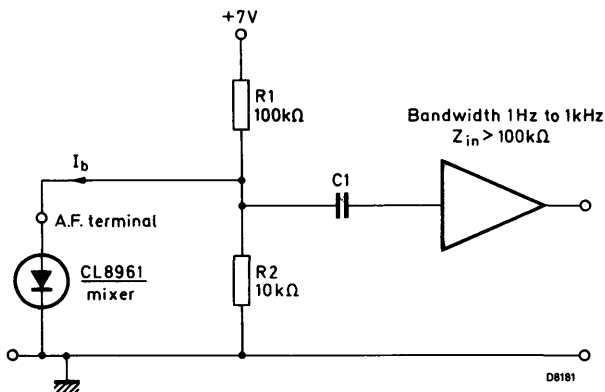
2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.
3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.
4. Noise measured at a frequency 1Hz to 1kHz from carrier.
5. The Gunn device will be damaged if the supply is reversed.
6. The module is supplied with a protection circuit connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the protection circuit is not removed when all wiring has been completed.
7. Precautions similar to those required for CMOS devices are necessary, namely:
 - a) Earthed wrist straps should be worn.
 - b) Table tops or other working surfaces should be conductive and earthed.
 - c) Anti-static clothing should be worn.
 - d) No electrical testing should be carried out without specific, approved and written test procedures.
 - e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.
8. The above conditions apply when operated into the antenna supplied with the module.
9. A 10nF capacitor should be connected across and close to the +7V and earth terminals to suppress parasitic oscillations in the power supply.
10. $\frac{\text{Signal} + \text{noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

OUTLINE DRAWING





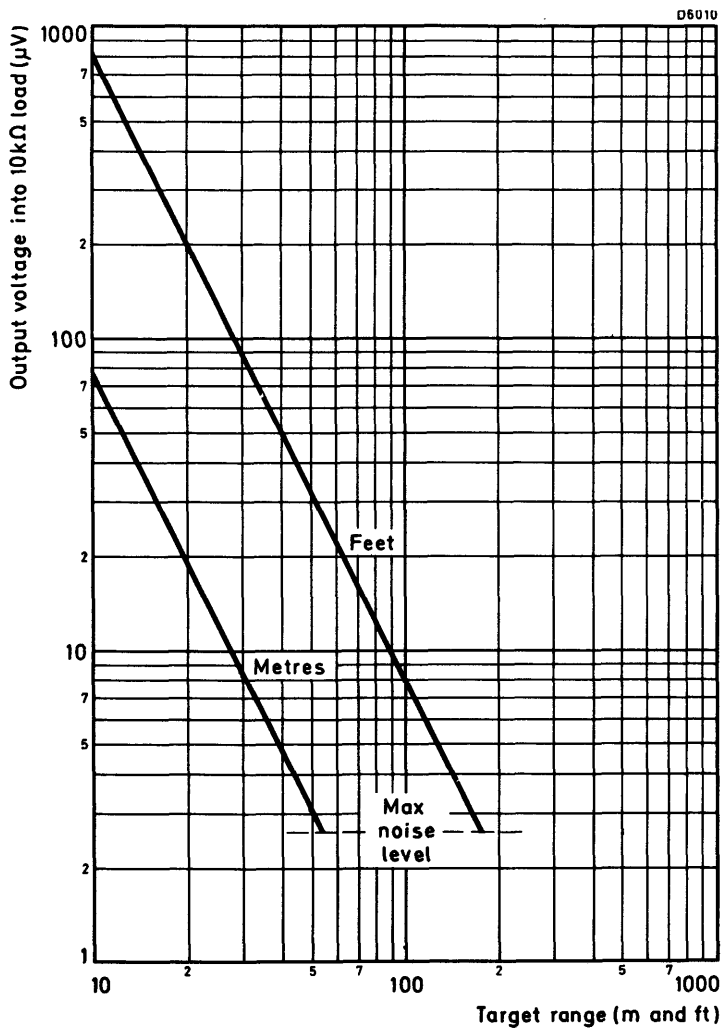
Gunn device characteristic



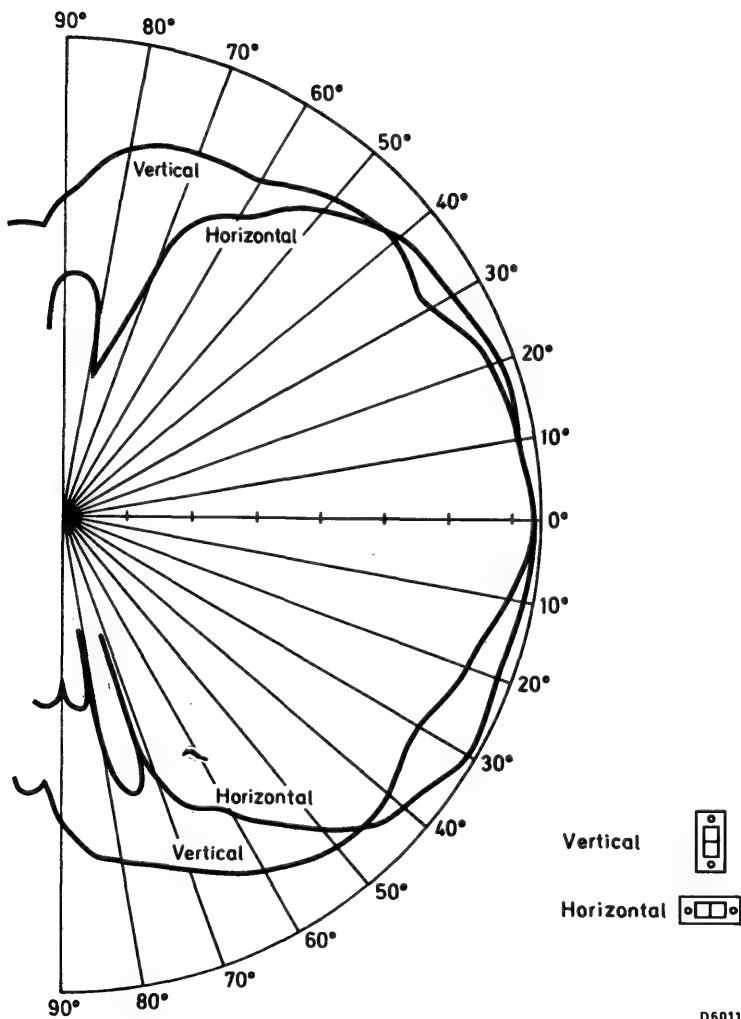
Circuit used to measure A.F. performance

Notes

1. The current I_b should be approximately $35\mu A$ with the Gunn device disconnected and approximately $42\mu A$ with the Gunn device operational and the antenna operating into free space.
2. The coupling capacitor should have a small impedance compared with Z_{in} .



Minimum output for a man target



Polar diagram for antenna supplied.

MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6mm thick metal plate with aperture dimensions as shown on page 9.

In this configuration, the metal plate forms the front panel of the equipment, and the antenna radiates into free space. If the equipment housing is all metal, any back radiation will be totally contained. Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.

The total mixer bias under the optimum operating conditions is approximately 42 μ A. (35 μ A d.c. bias + 7 μ A from -19dBm of coupled l.o. power.)

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

In this case, the l.o. power coupled to the mixer will be -11dBm, and the total mixer bias current will now be approximately 60 μ A.

The increase in l.o. power will, in general give rise to an increase in a.f. output voltage for a given target, but this will be accompanied by a degradation in signal to noise ratio. For -11dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.

However, further increase in the level of coupled l.o. power arising from the use of thick or 'microwave' reflective covering materials, will:

- (a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.
- (b) present a mismatch to the Gunn oscillator which may impair the switching and running performance and may 'pull' the frequency outside the allocated operating frequency band.

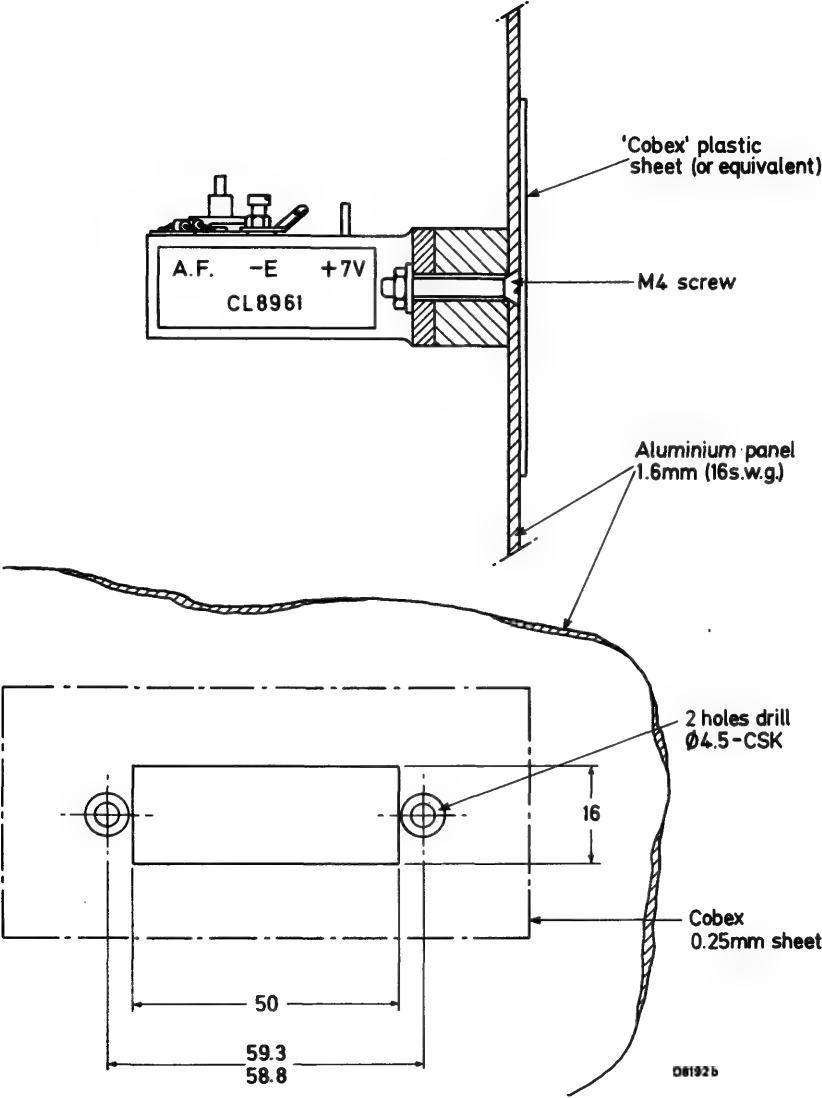
The following table compares the l.o. coupling level obtained for different covering materials at the antenna.

| L. O. coupling (dBm) | Mixer total bias (μ A) | Antenna covering material |
|-------------------------|--------------------------------|--|
| - | 35 (d.c. only) | - |
| -19 | 42 | No covering |
| -15 | 50 | 1 to 2cm expanded polythene or polystyrene |
| -11 | 61 | 0.25mm Cobex plastic |
| -6 | 70 | 0.5mm Cobex plastic |

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**X-BAND DOPPLER
RADAR MODULE**

CL8961



X-BAND DOPPLER RADAR MODULE

CL8962

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 9.5 GHz band. Applications include all forms of Doppler radar systems.

| | | |
|--|------|---------------|
| Centre frequency | 9.47 | GHz |
| Power output (at 7.0V) typ. | 10 | mW |
| Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$ (see page 6 and note 1) | 40 | μV |
| Supply voltage | 7.0 | V |



Mullard

OPERATING CONDITIONS

| | | |
|--|------------|----|
| Supply voltage (see note 2) | +7.0 ± 0.1 | V |
| Supply current (see note 3) (typ.) | 140 | mA |
| D. C. mixer bias current (into a.f. terminal w.r.t. earth) | 30 to 35 | μA |
| A.F. load (see page 5) | 10 | kΩ |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|------------|----|
| Supply voltage (max. d.c.) | +7.5 | V |
| Supply voltage transient max. (1.0ms max.) | 9.0 | V |
| T _{stg} range | -10 to +70 | °C |
| T _{amb} range | 0 to +40 | °C |

→ CHARACTERISTICS at 25 °C

| | Min. | Typ. | Max. | |
|---|------------|-------|-------|--------|
| Centre frequency | - | 9.470 | - | GHz |
| Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$) (see notes 1 and 4 and page 6) | 20 | 40 | - | μV |
| Output power at 7.0V | - | 10 | - | mW |
| Frequency fixed | 9.458 | 9.470 | 9.482 | GHz |
| Frequency temperature coefficient | - | -0.2 | -0.3 | MHz/°C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| Diode current (see note 3) | - | 130 | 165 | mA |
| Polar diagram | see page 7 | | | |

MASS

210

g

Alternative antennae and operating frequencies may be made to suit customers' specific requirements.

OPERATING NOTES

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB typ.).

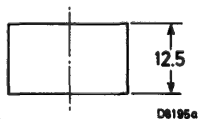
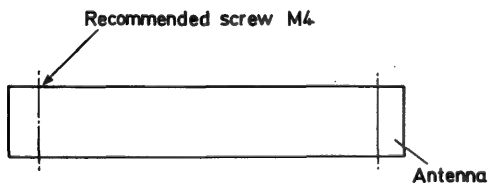
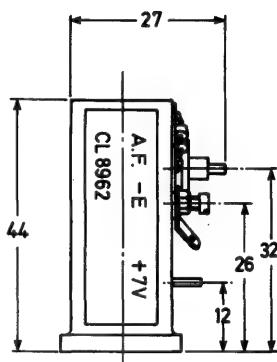
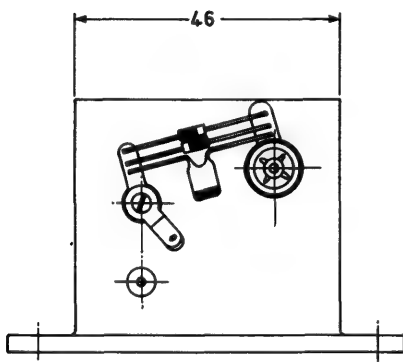
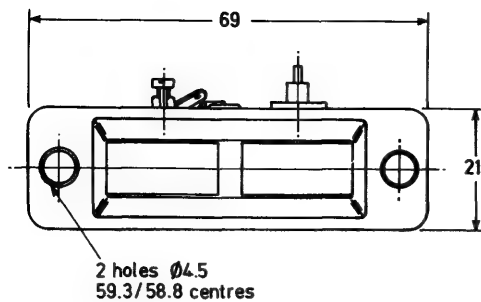
Extended range may be obtained for a reduced $\frac{\text{signal} + \text{noise}}{\text{noise}}$ and this may be

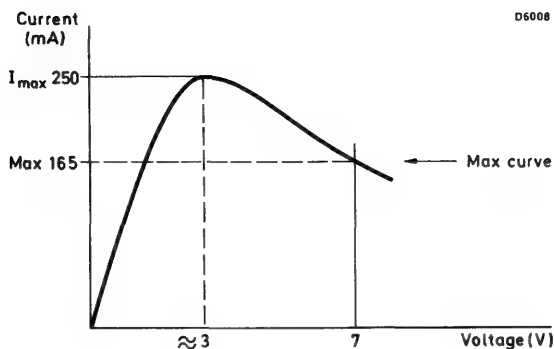
acceptable if the environment in which the system operates is stable, i.e., free from extraneous moving or vibrating objects. For example, 110dB path loss is obtained from a man target of radar cross-section 1.0m^2 at a range of 25m and the $\frac{\text{signal} + \text{noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of $16\mu\text{V}$ min.

Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to Mullard Ltd.

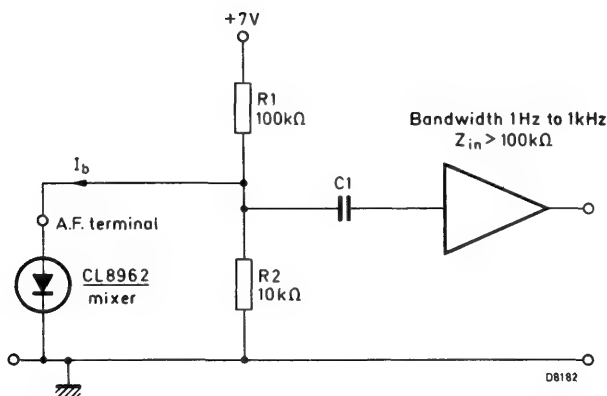
2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.
3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.
4. Noise measured at a frequency 1Hz to 1kHz from carrier.
5. The Gunn device will be damaged if the supply is reversed.
6. The module is supplied with a protection circuit connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the protection circuit is not removed when all wiring has been completed.
7. Precautions similar to those required for CMOS devices are necessary, namely:
 - a) Earthed wrist straps should be worn.
 - b) Table tops or other working surfaces should be conductive and earthed.
 - c) Anti-static clothing should be worn.
 - d) No electrical testing should be carried out without specific, approved and written test procedures.
 - e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.
8. The above conditions apply when operated into the antenna supplied with the module.
9. A 10nF capacitor should be connected across and close to the +7V and earth terminals to suppress parasitic oscillations in the power supply.
10. $\frac{\text{Signal} + \text{noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

OUTLINE DRAWING





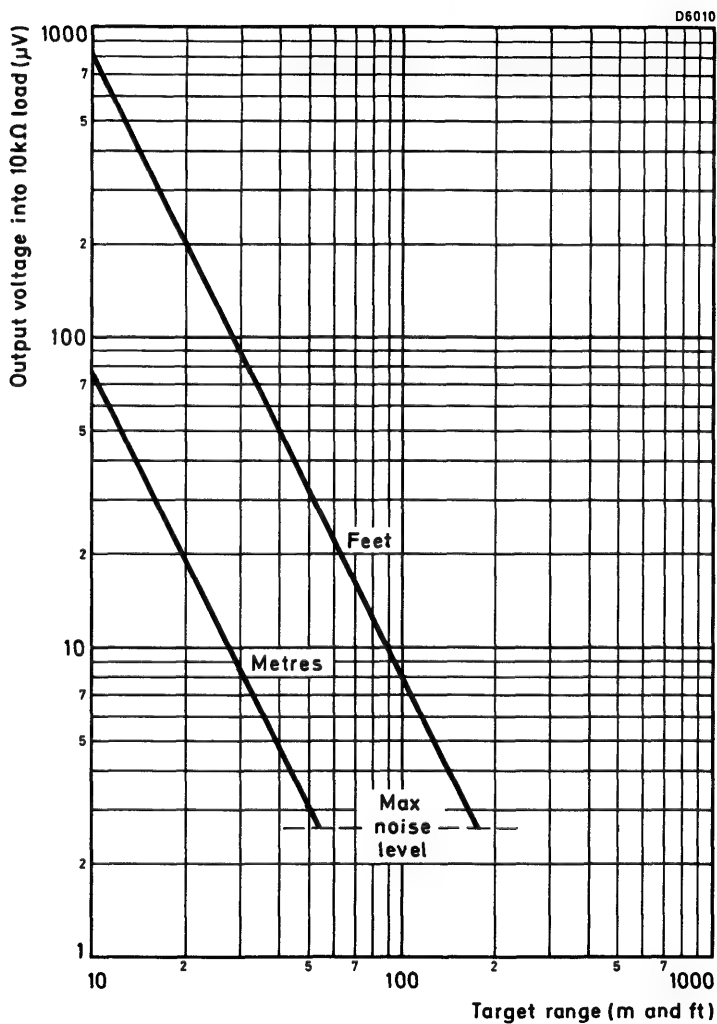
Gunn device characteristic



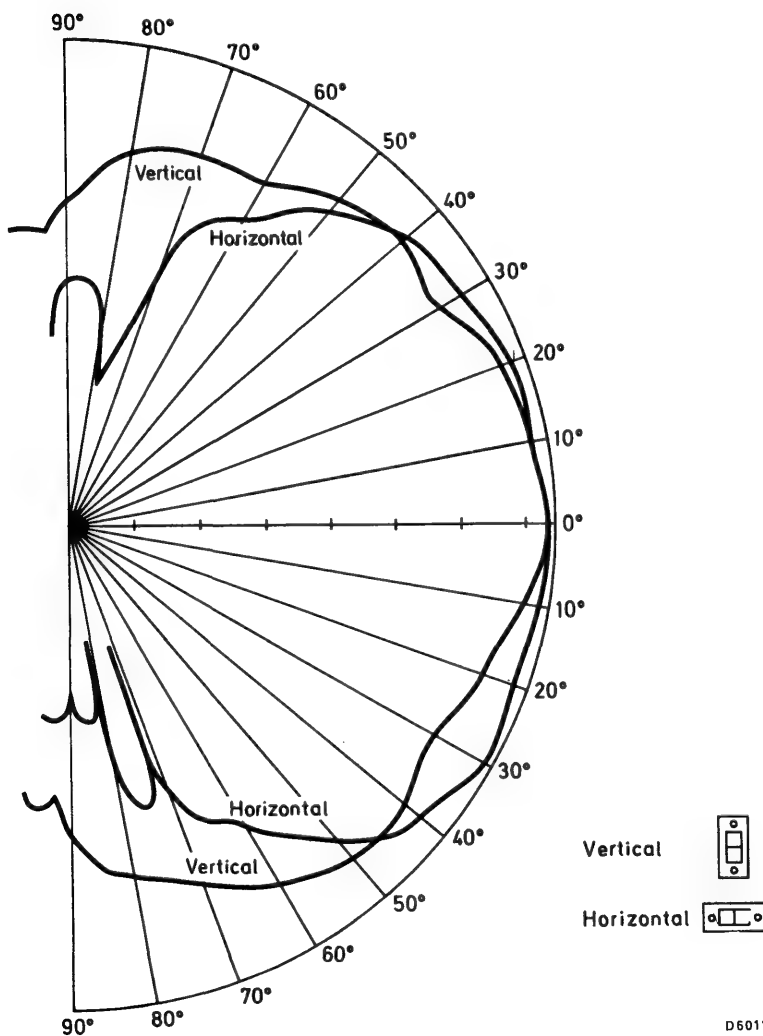
Circuit used to measure A.F. performance

Notes

1. The current I_b should be approximately $35\mu A$ with the Gunn device disconnected and approximately $42\mu A$ with the Gunn device operational and the antenna operating into free space.
2. The coupling capacitor should have a small impedance compared with Z_{in} .



Minimum output for a man target



Polar diagram for antenna supplied.

MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6mm thick metal plate with aperture dimensions as shown on page 9.

In this configuration, the metal plate forms the front panel of the equipment, and the antenna radiates into free space. If the equipment housing is all metal, any back radiation will be totally contained. Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.

The total mixer bias under the optimum operating conditions is approximately $42\mu\text{A}$. ($35\mu\text{A}$ d.c. bias + $7\mu\text{A}$ from -19dBm of coupled l.o. power.)

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

In this case, the l.o. power coupled to the mixer will be -11dBm , and the total mixer bias current will now be approximately $60\mu\text{A}$.

The increase in l.o. power will, in general give rise to an increase in a.f. output voltage for a given target, but this will be accompanied by a degradation in signal to noise ratio. For -11dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.

However, further increase in the level of coupled l.o. power arising from the use of thick or 'microwave' reflective covering materials, will:

- (a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.
- (b) present a mismatch to the Gunn oscillator which may impair the switching and running performance and may 'pull' the frequency outside the allocated operating frequency band.

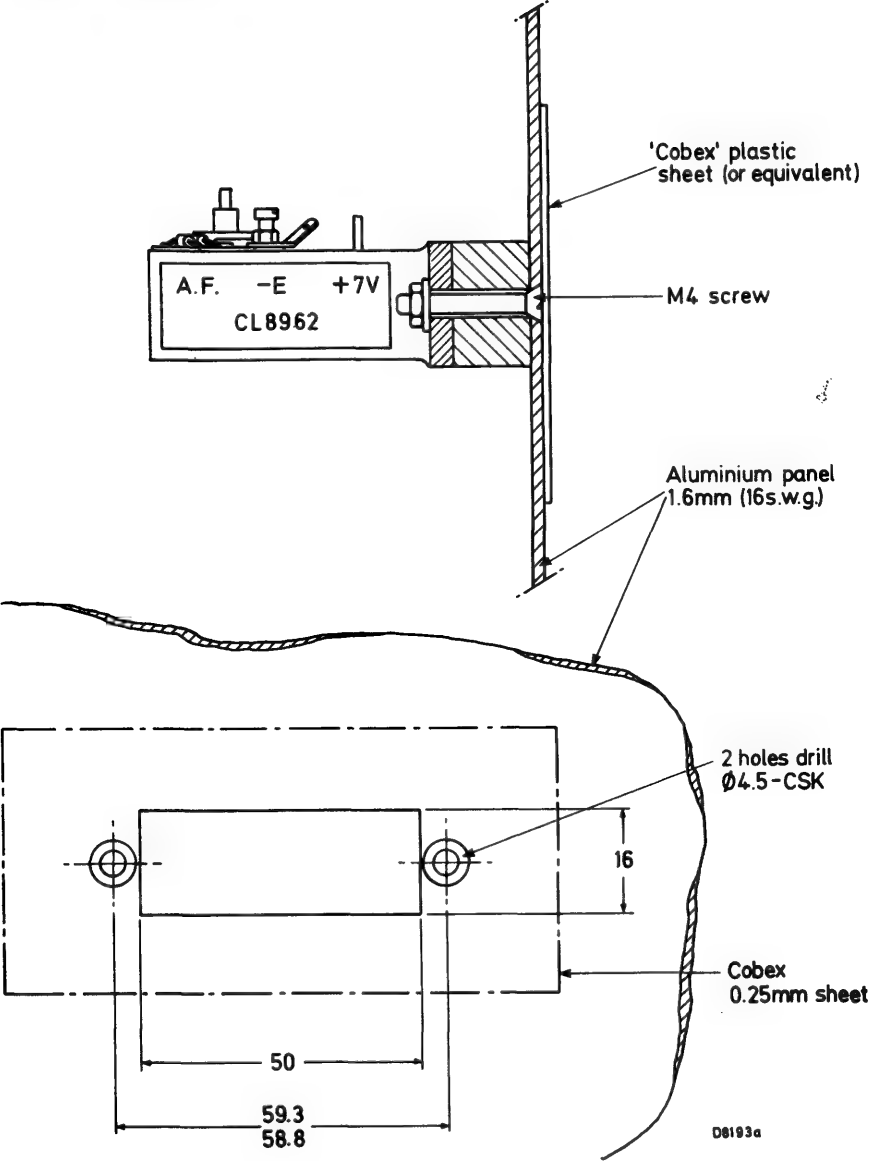
The following table compares the l.o. coupling level obtained for different covering materials at the antenna.

| L. O. coupling (dBm) | Mixer total bias (μA) | Antenna covering material |
|-------------------------|---------------------------------------|--|
| - | 35 (d.c. only) | - |
| -19 | 42 | No covering |
| -15 | 50 | 1 to 2cm expanded polythene or polystyrene |
| -11 | 61 | 0.25mm Cobex plastic |
| -6 | 70 | 0.5mm Cobex plastic |

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**X-BAND DOPPLER
RADAR MODULE**

CL8962



Panel mounting details

X-BAND DOPPLER RADAR MODULE

CL8963

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.5GHz band. Applications include all forms of Doppler radar systems.

| | | |
|--|--------|---------------|
| Centre frequency | 10.525 | GHz |
| Power output (at 7.0V) typ. | 10 | mW |
| Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$ (see page 6 and note 1) | 40 | μV |
| Supply voltage | 7.0 | V |



Mullard

OPERATING CONDITIONS

| | | |
|---|------------|----|
| Supply voltage (see note 2) | +7.0 ± 0.1 | V |
| Supply current (see note 3) (typ.) | 140 | mA |
| D. C. mixer bias current (into a. f. terminal w. r. t. earth) | 30 to 35 | μA |
| A. F. load (see page 5) | 10 | kΩ |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|---|------------|----|
| Supply voltage (max. d. c.) | +7.5 | V |
| Supply voltage transient max. (1.0ms max.) | 9.0 | V |
| T _{stg} range | -10 to +70 | °C |
| T _{amb} range | 0 to +40 | °C |

CHARACTERISTICS at 25 °C

| | Min. | Typ. | Max. | |
|---|--------|------------|--------|--------|
| Centre frequency | - | | - | GHz |
| Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$) (see notes 1 and 4 and page 6) | 20 | 40 | - | μV |
| Output power at 7.0V | - | 10 | - | mW |
| Frequency fixed | 10.513 | 10.525 | 10.537 | GHz |
| Frequency temperature coefficient | - | -0.2 | -0.3 | MHz/°C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| Second harmonic | - | -35 | - | dBm |
| Diode current (see note 3) | - | 130 | 165 | mA |
| Polar diagram | | see page 7 | | |
| MASS | | 170 | | g |

Alternative antennae and operating frequencies may be made to suit customers' specific requirements.

OPERATING NOTES

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB typ.).

Extended range may be obtained for a reduced $\frac{\text{signal} + \text{noise}}{\text{noise}}$ and this may be

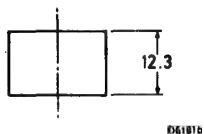
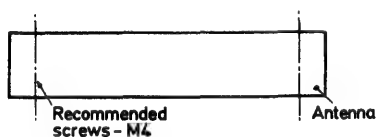
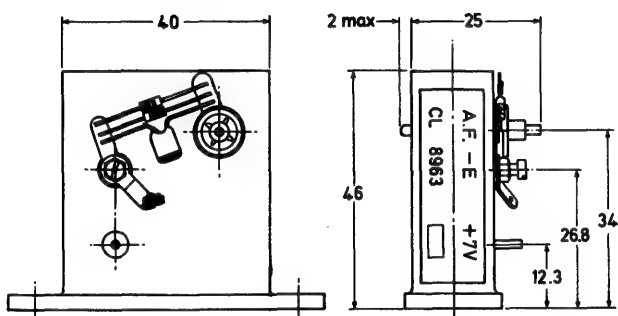
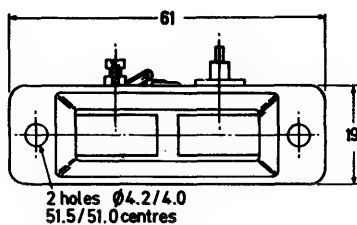
acceptable if the environment in which the system operates is stable, i.e. , free from extraneous moving or vibrating objects. For example, 110dB path loss is obtained from a man target of radar cross-section 1.0m^2 at a range of 25m and the $\frac{\text{signal} + \text{noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of $16\mu\text{V}$ min.

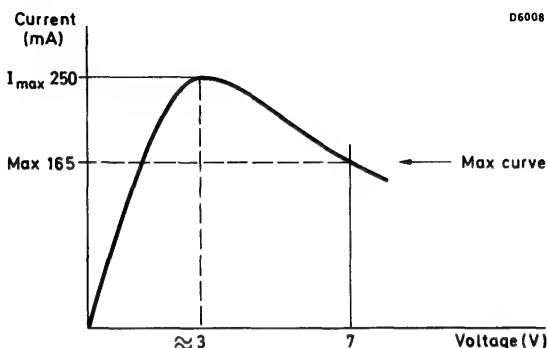
Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to Mullard Ltd.

2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.
3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.
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6. The module is supplied with a protection circuit connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the protection circuit is not removed when all wiring has been completed.
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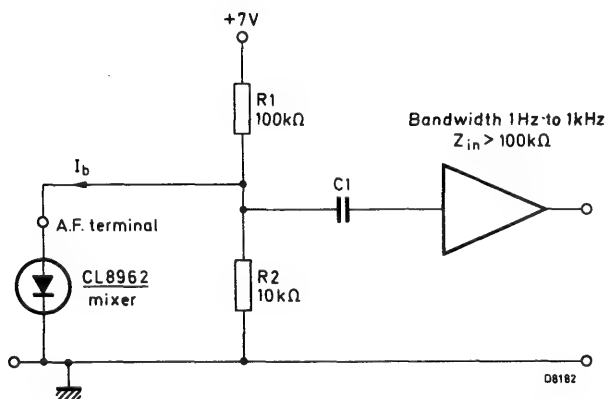


OUTLINE DRAWING





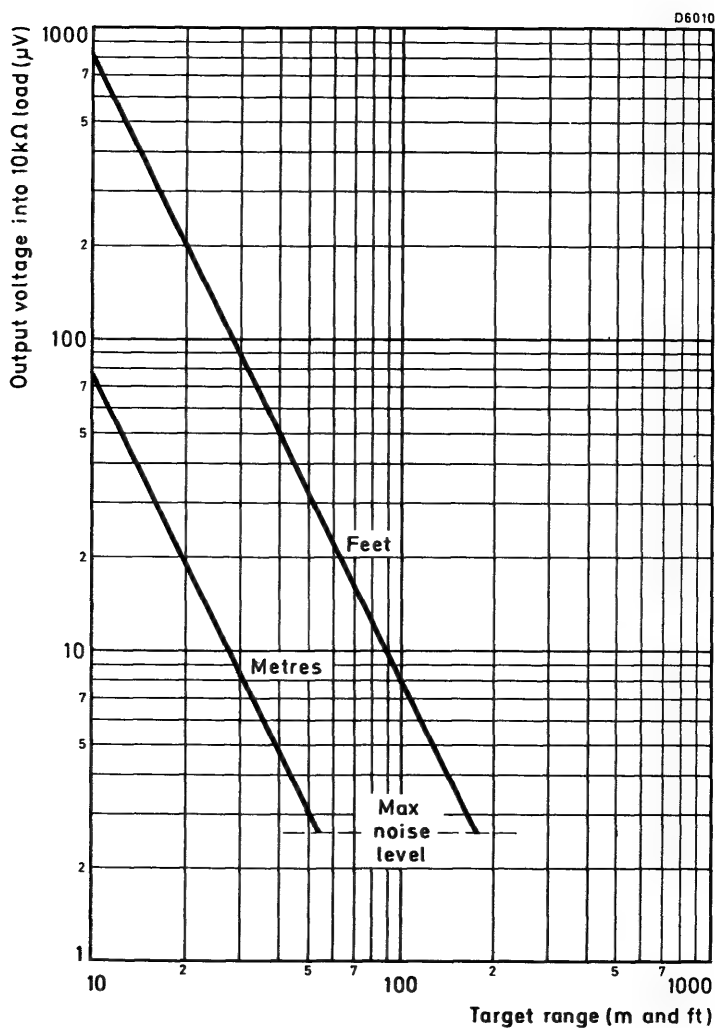
Gunn device characteristic



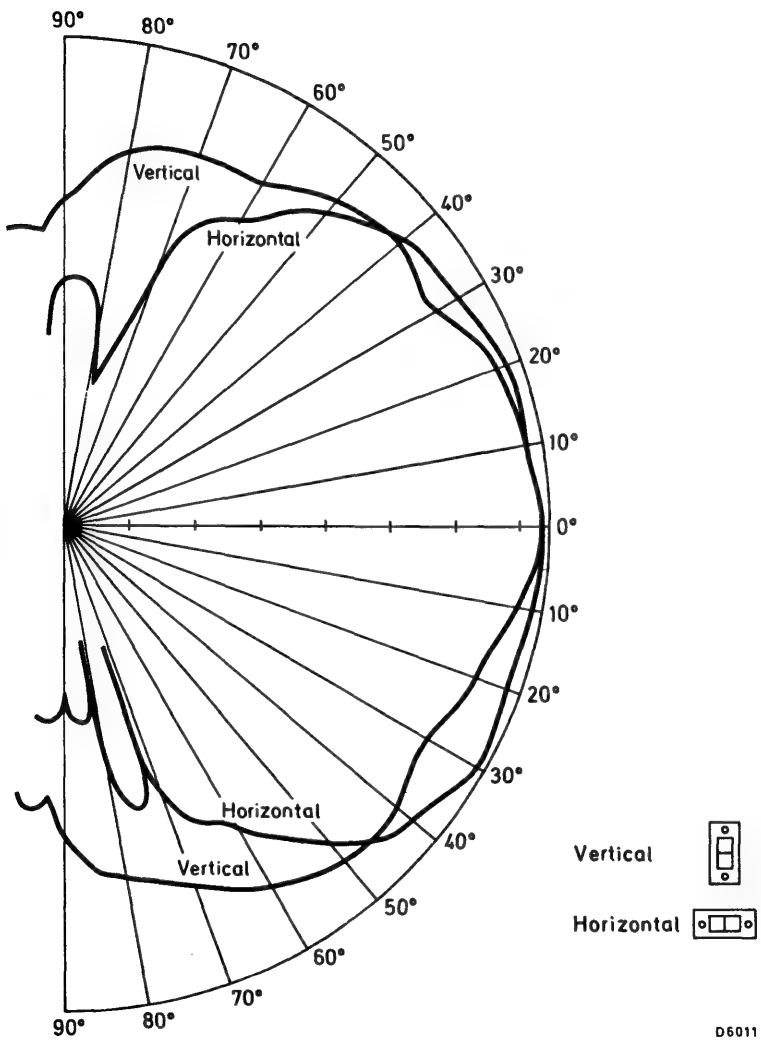
Circuit used to measure A.F. performance

Notes

1. The current I_b should be approximately 35 μ A with the Gunn device disconnected and approximately 42 μ A with the Gunn device operational and the antenna operating into free space.
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Minimum output for a man target



Polar diagram for antenna supplied.

MODULE MOUNTING

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The total mixer bias under the optimum operating conditions is approximately $42\mu\text{A}$. ($35\mu\text{A}$ d.c. bias + $7\mu\text{A}$ from -19dBm of coupled l.o. power.)

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

In this case, the l.o. power coupled to the mixer will be -11dBm, and the total mixer bias current will now be approximately $60\mu\text{A}$.

The increase in l.o. power will, in general give rise to an increase in a.f. output voltage for a given target, but this will be accompanied by a degradation in signal to noise ratio. For -11dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.

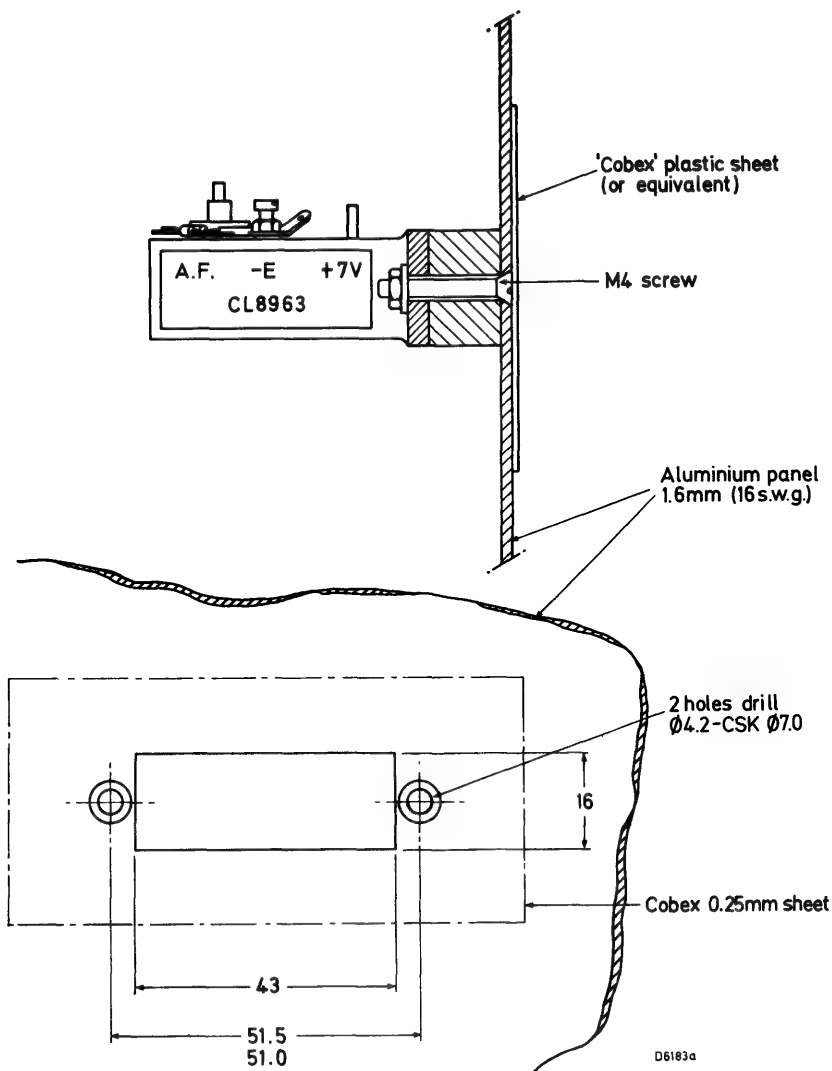
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- (a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.
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The following table compares the l.o. coupling level obtained for different covering materials at the antenna.

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|-------------------------|---------------------------------------|--|
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| -19 | 42 | No covering |
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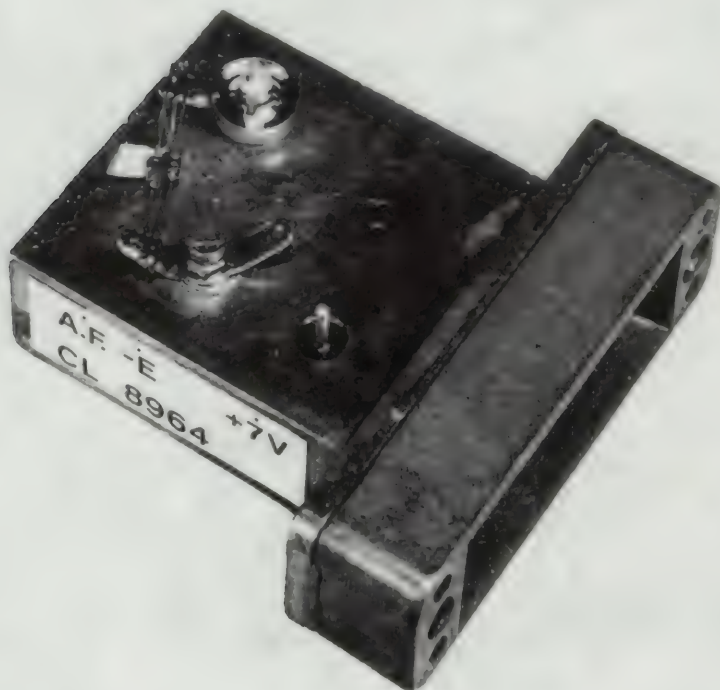


Panel mounting details

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 9.9 GHz band. Applications include all forms of Doppler radar systems.

| | | |
|--|-------|---------------|
| Centre frequency | 9.900 | GHz |
| Power output (at 7.0V) typ. | 10 | mW |
| Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$ (see page 6 and note 1) | 40 | μV |
| Supply voltage | 7.0 | V |



OPERATING CONDITIONS

| | | |
|---|----------------|------------|
| Supply voltage (see note 2) | +7.0 \pm 0.1 | V |
| Supply current (see note 3) (typ.) | 140 | mA |
| D.C. mixer bias current (into a.f. terminal w.r.t. earth) | 30 to 35 | μ A |
| A.F. load (see page 5) | 10 | k Ω |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--|------------|--------------|
| Supply voltage (max. d.c.) | +7.5 | V |
| Supply voltage transient max. (1.0ms max.) | 9.0 | V |
| T _{stg} range | -10 to +70 | $^{\circ}$ C |
| T _{amb} range | 0 to +40 | $^{\circ}$ C |

CHARACTERISTICS at 25 $^{\circ}$ C

| | Min. | Typ. | Max. | |
|---|------------|-------|--------|-------------------|
| Centre frequency | - | 9.990 | - | GHz |
| Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$) (see notes 1 and 4 and page 6) | 20 | 40 | - | μ V |
| Output power at 7.0V | - | 10 | - | mW |
| Frequency fixed | 9.978 | 9.990 | 10.002 | GHz |
| Frequency temperature coefficient | - | -0.2 | -0.3 | MHz/ $^{\circ}$ C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| Second harmonic | - | -35 | - | dBm |
| Diode current (see note 3) | - | 130 | 165 | mA |
| Polar diagram | see page 7 | | | |
| MASS | | 170 | | g |

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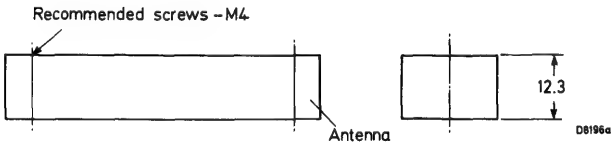
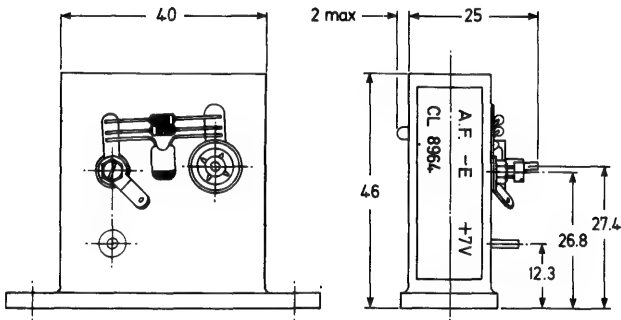
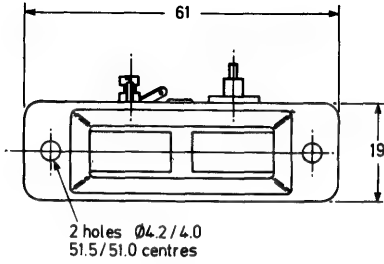
OPERATING NOTES

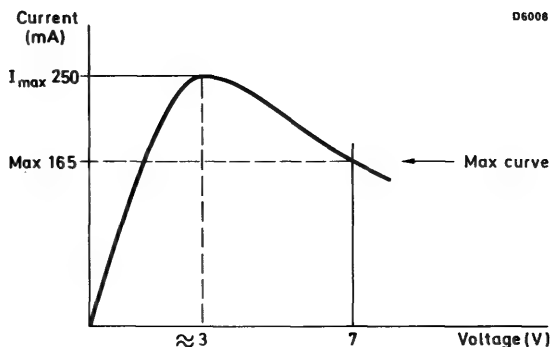
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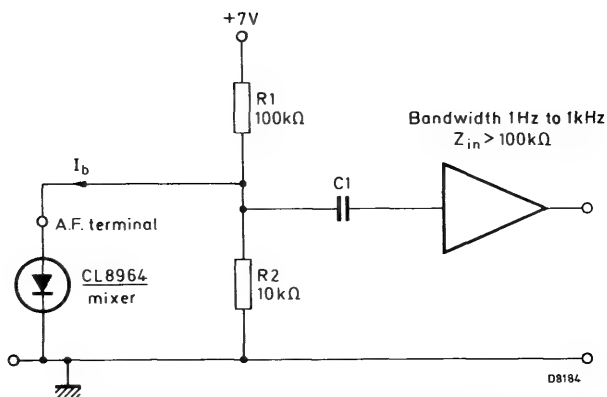
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8. The above conditions apply when operated into the antenna supplied with the module.
9. A 10nF capacitor should be connected across and close to the +7V and earth terminals to suppress parasitic oscillations in the power supply.
10. $\frac{\text{Signal} + \text{noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

OUTLINE DRAWING





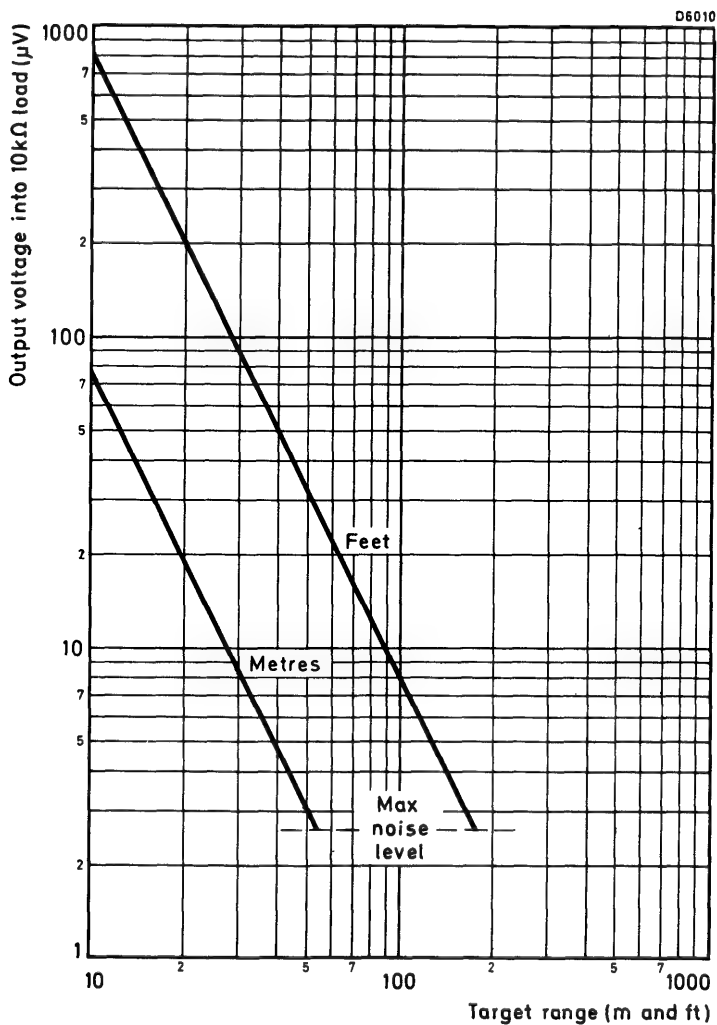
Gunn device characteristic



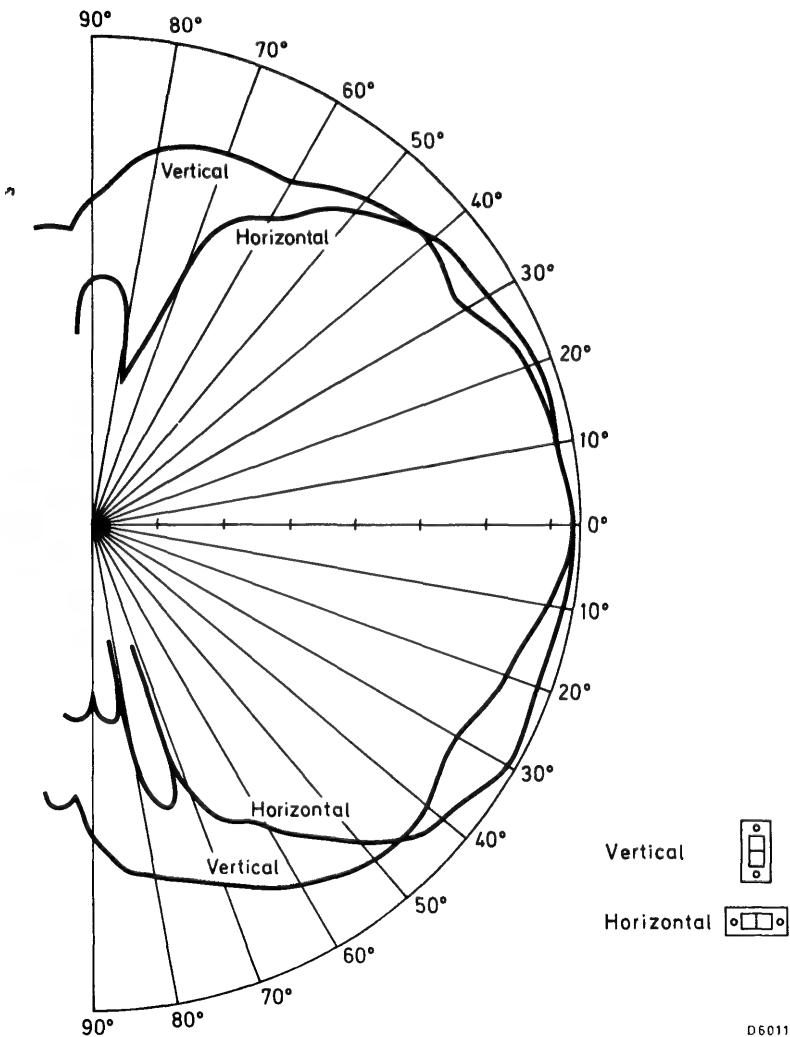
Circuit used to measure A.F. performance.

Notes

1. The current I_b should be approximately 35 μ A with the Gunn device disconnected and approximately 42 μ A with the Gunn device operational and the antenna operating into free space.
2. The coupling capacitor should have a small impedance compared with Z_{in} .



Minimum output for a man target



Polar diagram for antenna supplied.

MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6mm thick metal plate with aperture dimensions as shown on page 9.

In this configuration, the metal plate forms the front panel of the equipment, and the antenna radiates into free space. If the equipment housing is all metal, any back radiation will be totally contained. Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.

The total mixer bias under the optimum operating conditions is approximately 42 μ A. (35 μ A d.c. bias + 7 μ A from -19dBm of coupled l.o. power.)

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

In this case, the l.o. power coupled to the mixer will be -11dBm, and the total mixer bias current will now be approximately 60 μ A.

The increase in l.o. power will, in general give rise to an increase in a.f. output voltage for a given target, but this will be accompanied by a degradation in signal to noise ratio. For -11dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.

However, further increase in the level of coupled l.o. power arising from the use of thick or 'microwave' reflective covering materials, will:

- (a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.
- (b) present a mismatch to the Gunn oscillator which may impair the switching and running performance and may 'pull' the frequency outside the allocated operating frequency band.

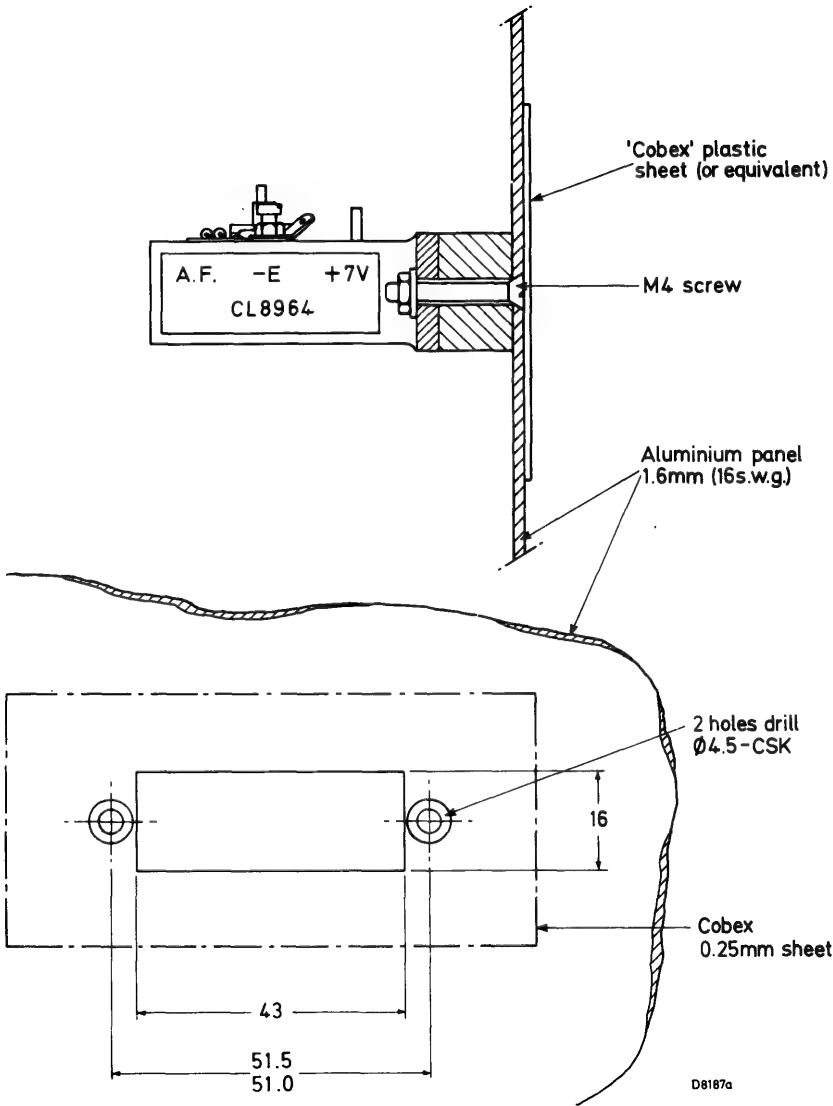
The following table compares the l.o. coupling level obtained for different covering materials at the antenna.

| L. O. coupling (dBm) | Mixer total bias (μ A) | Antenna covering material |
|-------------------------|--------------------------------|--|
| - | 35 (d.c. only) | - |
| -19 | 42 | No covering |
| -15 | 50 | 1 to 2cm expanded polythene or polystyrene |
| -11 | 61 | 0.25mm Cobex plastic |
| -6 | 70 | 0.5mm Cobex plastic |

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**X-BAND DOPPLER
RADAR MODULE**

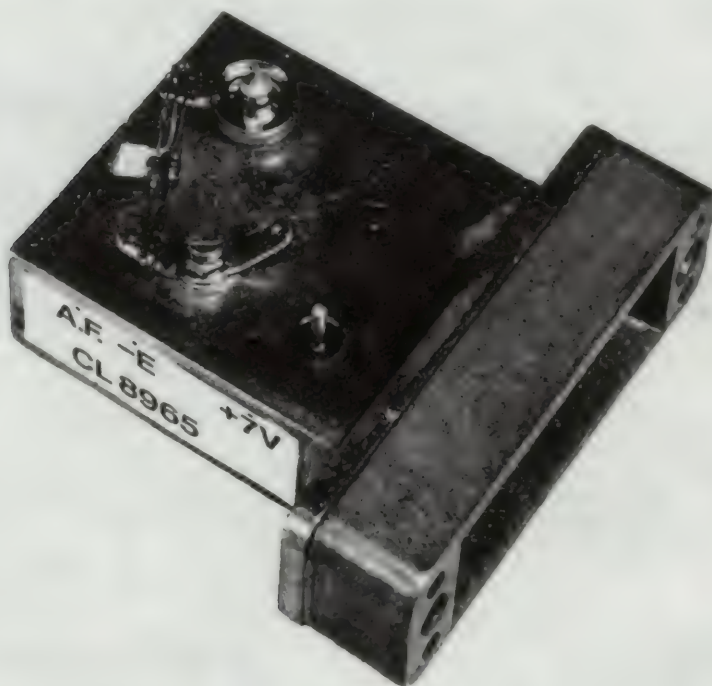
CL8964



QUICK REFERENCE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.6GHz band. Applications include all forms of Doppler radar systems.

| | | |
|--|--------|---------------|
| Centre frequency | 10.565 | GHz |
| Power output (at 7.0V) typ. | 10 | mW |
| Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$ (see page 6 and note 1) | 40 | μV |
| Supply voltage | 7.0 | V |



OPERATING CONDITIONS

| | | |
|---|----------------|------------|
| Supply voltage (see note 2) | +7.0 \pm 0.1 | V |
| Supply current (see note 3) (typ.) | 140 | mA |
| D. C. mixer bias current (into a. f. terminal w. r. t. earth) | 30 to 35 | μ A |
| A. F. load (see page 5) | 10 | k Ω |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--|------------|--------------|
| Supply voltage (max. d. c.) | +7.5 | V |
| Supply voltage transient max. (1.0ms max.) | 9.0 | V |
| T _{stg} range | -10 to +70 | $^{\circ}$ C |
| T _{amb} range | 0 to +40 | $^{\circ}$ C |

CHARACTERISTICS at 25 $^{\circ}$ C

| | Min. | Typ. | Max. | |
|--|------------|--------|--------|-------------------|
| Centre frequency | - | 10.565 | - | GHz |
| Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$) (see notes 1 and 4 and page 6) | 20 | 40 | - | μ V |
| Output power at 7.0V | - | 10 | - | mW |
| Frequency fixed | 10.553 | 10.565 | 10.577 | GHz |
| Frequency temperature coefficient | - | -0.2 | -0.3 | MHz/ $^{\circ}$ C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| Second harmonic | - | -35 | - | dBm |
| Diode current (see note 3) | - | 130 | 165 | mA |
| Polar diagram | see page 7 | | | |
| MASS | | 170 | | g |

Alternative antennae and operating frequencies may be made to suit customers' specific requirements.

OPERATING NOTES

1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB typ.).

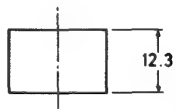
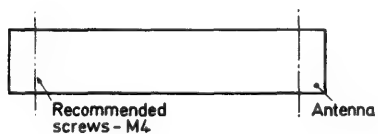
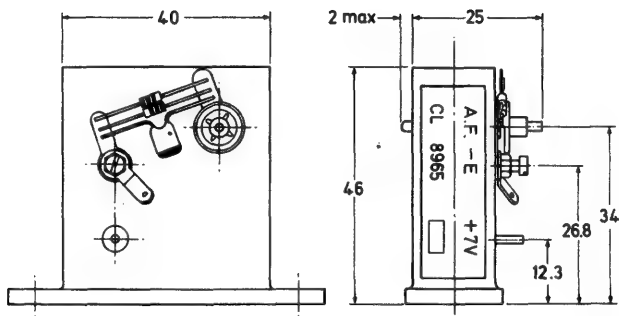
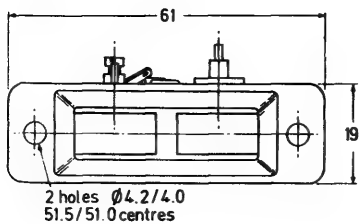
Extended range may be obtained for a reduced $\frac{\text{signal} + \text{noise}}{\text{noise}}$ and this may be acceptable if the environment in which the system operates is stable, i.e., free from extraneous moving or vibrating objects. For example, 110dB path loss is obtained from a man target of radar cross-section 1.0m^2 at a range of 25m and the $\frac{\text{signal} + \text{noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of 16 μV min.

Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to Mullard Ltd.

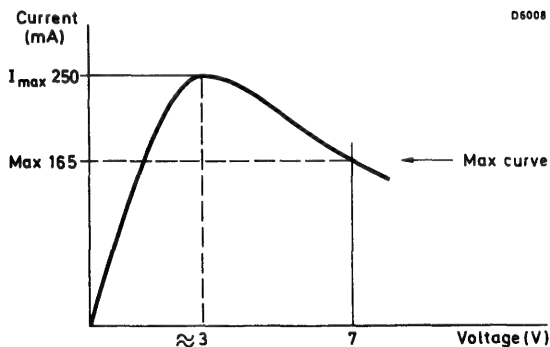
2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.
3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.
4. Noise measured at a frequency 1Hz to 1kHz from carrier.
5. The Gunn device will be damaged if the supply is reversed.
6. The module is supplied with a protection circuit connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the protection circuit is not removed when all wiring has been completed.
7. Precautions similar to those required for CMOS devices are necessary, namely:
 - a) Earthed wrist straps should be worn.
 - b) Table tops or other working surfaces should be conductive and earthed.
 - c) Anti-static clothing should be worn.
 - d) No electrical testing should be carried out without specific, approved and written test procedures.
 - e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.
8. The above conditions apply when operated into the antenna supplied with the module.
9. A 10nF capacitor should be connected across and close to the +7V and earth terminals to suppress parasitic oscillations in the power supply.
10. $\frac{\text{Signal} + \text{noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.



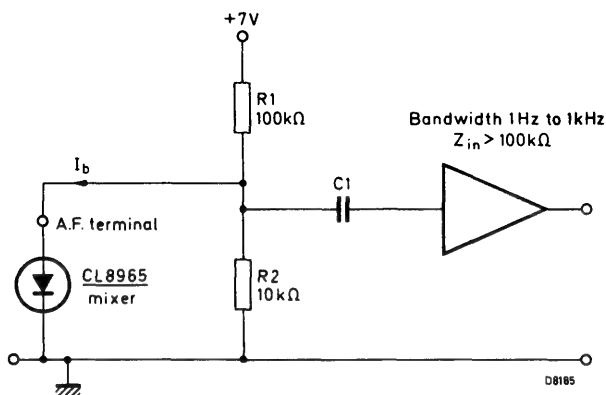
OUTLINE DRAWING



08190a



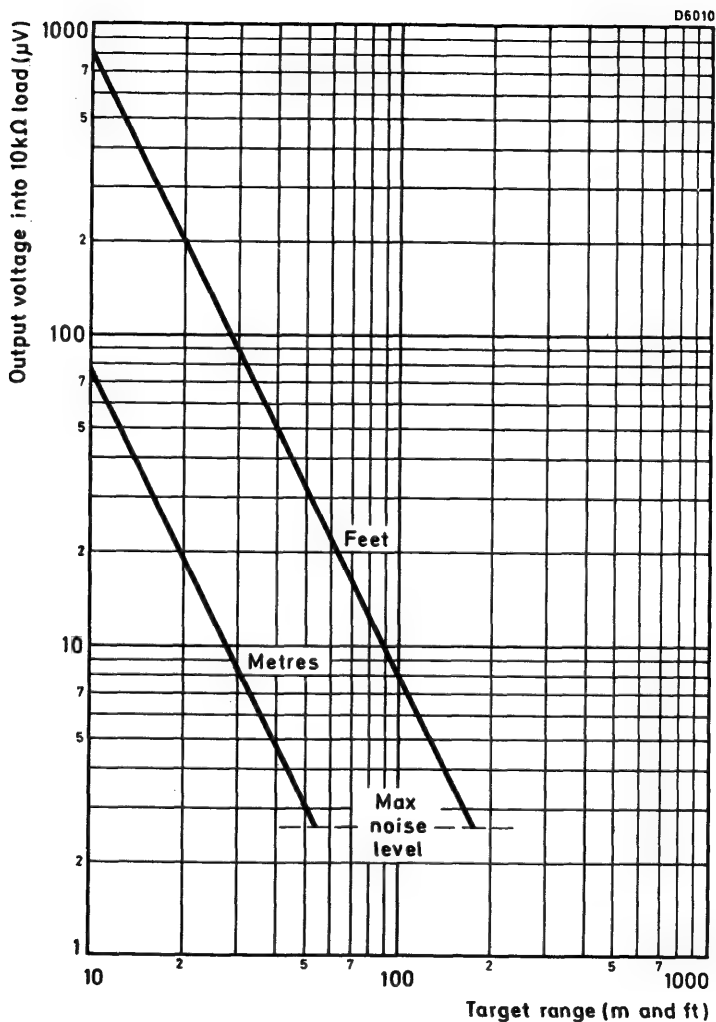
Gunn device characteristic



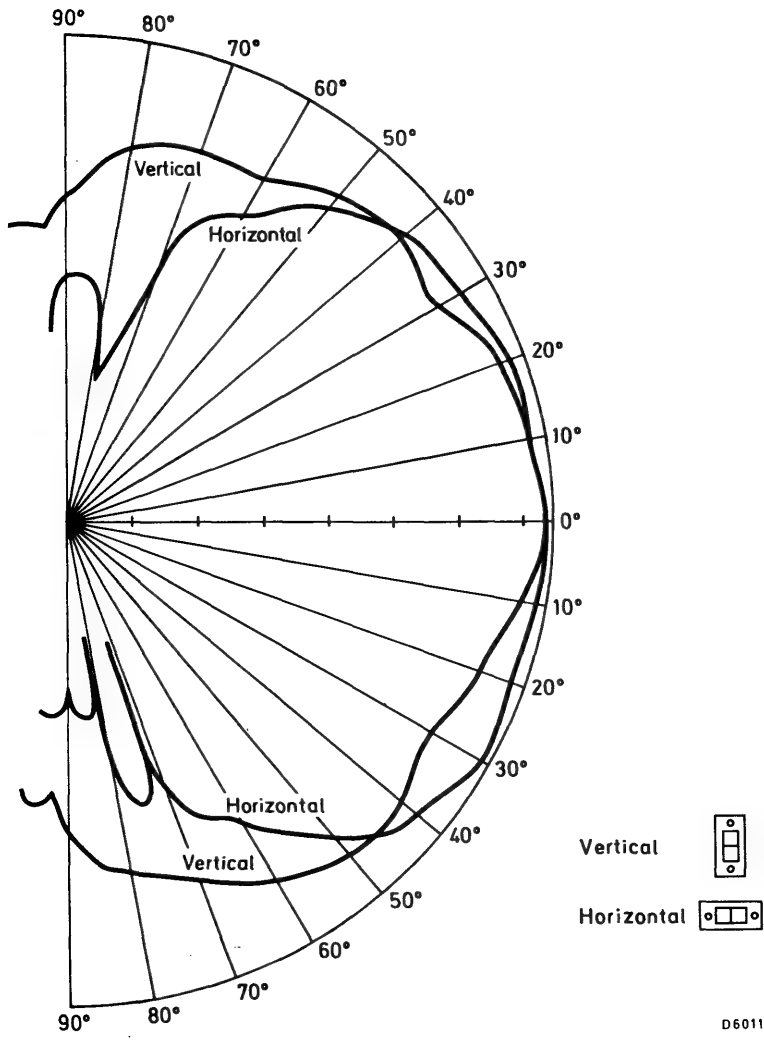
Circuit used to measure A.F. performance

Notes

1. The current I_b should be approximately 35 μ A with the Gunn device disconnected and approximately 42 μ A with the Gunn device operational and the antenna operating into free space.
2. The coupling capacitor should have a small impedance compared with Z_{in} .



Minimum output for a man target



Polar diagram for antenna supplied.

MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6mm thick metal plate with aperture dimensions as shown on page 9.

In this configuration, the metal plate forms the front panel of the equipment, and the antenna radiates into free space. If the equipment housing is all metal, any back radiation will be totally contained. Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.

The total mixer bias under the optimum operating conditions is approximately 42 μ A. (35 μ A d.c. bias + 7 μ A from -19dBm of coupled l.o. power.)

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

In this case, the l.o. power coupled to the mixer will be -11dBm, and the total mixer bias current will now be approximately 60 μ A.

The increase in l.o. power will, in general give rise to an increase in a.f. output voltage for a given target, but this will be accompanied by a degradation in signal to noise ratio. For -11dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.

However, further increase in the level of coupled l.o. power arising from the use of thick or 'microwave' reflective covering materials, will:

- (a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.
- (b) present a mismatch to the Gunn oscillator which may impair the switching and running performance and may 'pull' the frequency outside the allocated operating frequency band.

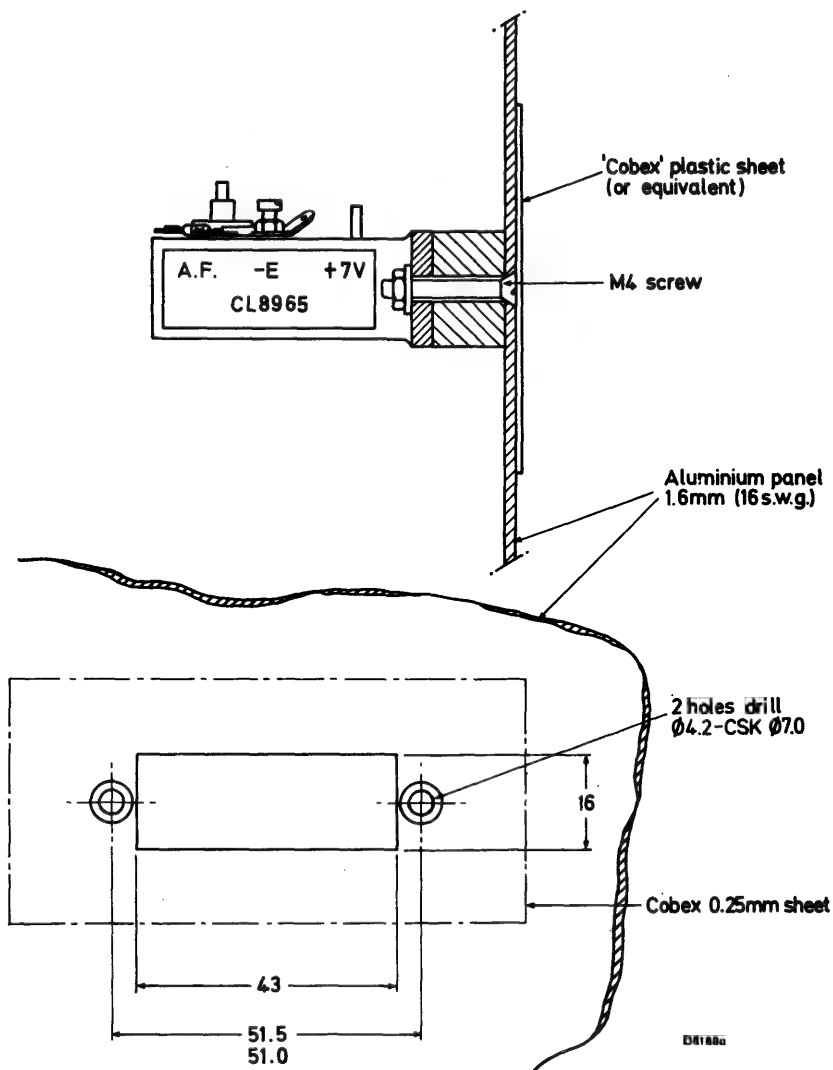
The following table compares the l.o. coupling level obtained for different covering materials at the antenna.

| L. O. coupling (dBm) | Mixer total bias (μ A) | Antenna covering material |
|-------------------------|--------------------------------|--|
| - | 35 (d.c. only) | - |
| -19 | 42 | No covering |
| -15 | 50 | 1 to 2cm expanded polythene or polystyrene |
| -11 | 61 | 0.25mm Cobex plastic |
| -6 | 70 | 0.5mm Cobex plastic |

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Brantham,
Manningtree, Essex CO11 1NJ

X-BAND DOPPLER RADAR MODULE

CL8965



Panel mounting details

Mullard

QUICK REFERENCE DATA

Fixed frequency Gunn oscillator and mixer cavity for operation in the 10.4GHz band. Applications include all forms of Doppler radar systems.

| | | |
|--|--------|---------------|
| Centre frequency | 10.365 | GHz |
| Power output (at 7.0V) typ. | 10 | mW |
| Output voltage (typ.) for input power 100dB down on output power at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$ (see page 6 and note 1) | 40 | μV |
| Supply voltage | 7.0 | V |



OPERATING CONDITIONS

| | | |
|---|------------|----|
| Supply voltage (see note 2) | +7.0 ± 0.1 | V |
| Supply current (see note 3) (typ.) | 140 | mA |
| D. C. mixer bias current (into a. f. terminal w. r. t. earth) | 30 to 35 | μA |
| A. F. load (see page 5) | 10 | kΩ |

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

| | | |
|--|------------|----|
| Supply voltage (max. d. c.) | +7.5 | V |
| Supply voltage transient max. (1.0ms max.) | 9.0 | V |
| T _{stg} range | -10 to +70 | °C |
| T _{amb} range | 0 to +40 | °C |

CHARACTERISTICS at 25 °C

| | Min. | Typ. | Max. | |
|--|------------|--------|--------|--------|
| Centre frequency | - | 10.365 | - | GHz |
| Output voltage for input power 100dB down on output power (at 18dB min. $\frac{\text{signal} + \text{noise}}{\text{noise}}$) (see notes 1 and 4 and page 6) | 20 | 40 | - | μV |
| Output power at 7.0V | - | 10 | - | mW |
| Frequency fixed | 10.353 | 10.365 | 10.377 | GHz |
| Frequency temperature coefficient | - | -0.2 | -0.3 | MHz/°C |
| Frequency pushing | - | 4.0 | - | MHz/V |
| Second harmonic | - | -35 | - | dBm |
| Diode current (see note 3) | - | 130 | 165 | mA |
| Polar diagram | see page 7 | | | |
| MASS | | 170 | | g |

Alternative antennae and operating frequencies may be made to suit customers' specific requirements.

OPERATING NOTES

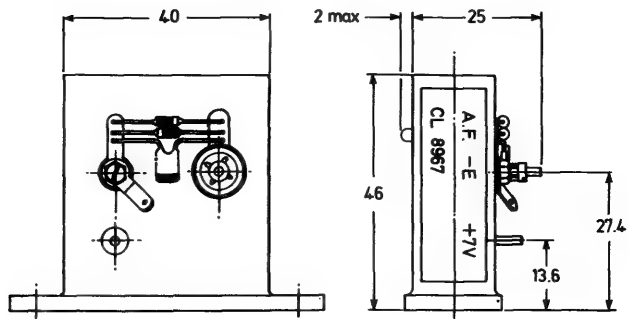
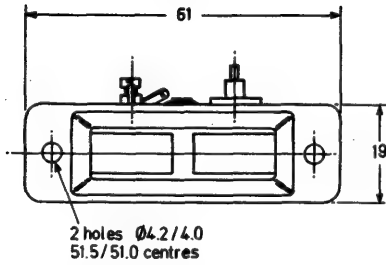
1. A return signal 100dB down on radiated power will be achieved from a man target of radar cross-section 1.0m^2 at a range of 15m, when operating with the antenna supplied (antenna gain is 5dB typ.).

Extended range may be obtained for a reduced $\frac{\text{signal} + \text{noise}}{\text{noise}}$ and this may be acceptable if the environment in which the system operates is stable, i.e., free from extraneous moving or vibrating objects. For example, 110dB path loss is obtained from a man target of radar cross-section 1.0m^2 at a range of 25m and the $\frac{\text{signal} + \text{noise}}{\text{noise}}$ is reduced to 15dB with an output voltage of 16 μ V min.

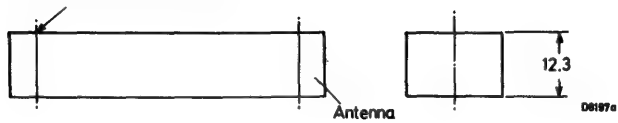
Alternatively, the range may be increased by an increase in target radar cross-section or by the use of a high gain antenna. The performance may then be calculated from the radar range equation. Further related information may be obtained on application to Mullard Ltd.

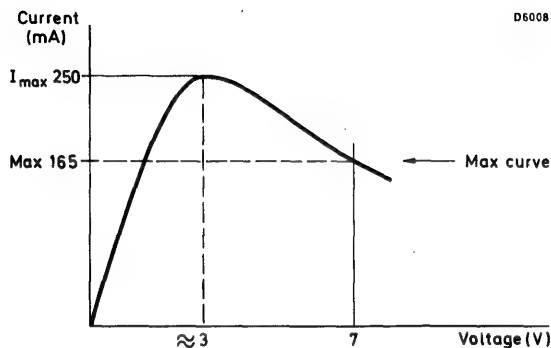
2. It is essential that the earth terminal is used as the common return for the Gunn voltage (+7V) and the d.c. bias supplied to the a.f. terminal.
3. The Gunn effect device has a voltage current characteristic as shown on page 5. The power supply should have a low source impedance and be capable of supplying up to 250mA at approximately 3V during the switch-on phase.
4. Noise measured at a frequency 1Hz to 1kHz from carrier.
5. The Gunn device will be damaged if the supply is reversed.
6. The module is supplied with a protection circuit connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the protection circuit is not removed when all wiring has been completed.
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 - e) To prevent the development of damaging transient voltages, devices should not be inserted or removed from test fixtures with power applied.
8. The above conditions apply when operated into the antenna supplied with the module.
9. A 10nF capacitor should be connected across and close to the +7V and earth terminals to suppress parasitic oscillations in the power supply.
10. $\frac{\text{Signal} + \text{noise}}{\text{noise}}$ performance may be degraded if the antenna is covered by a radome of unsuitable construction. Page 8 describes the preferred arrangement.

OUTLINE DRAWING

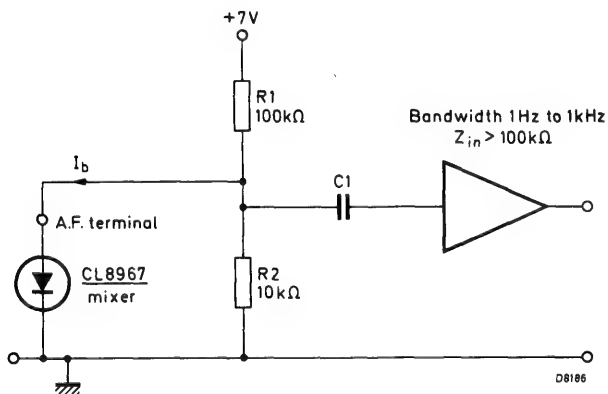


Recommended screws - M4





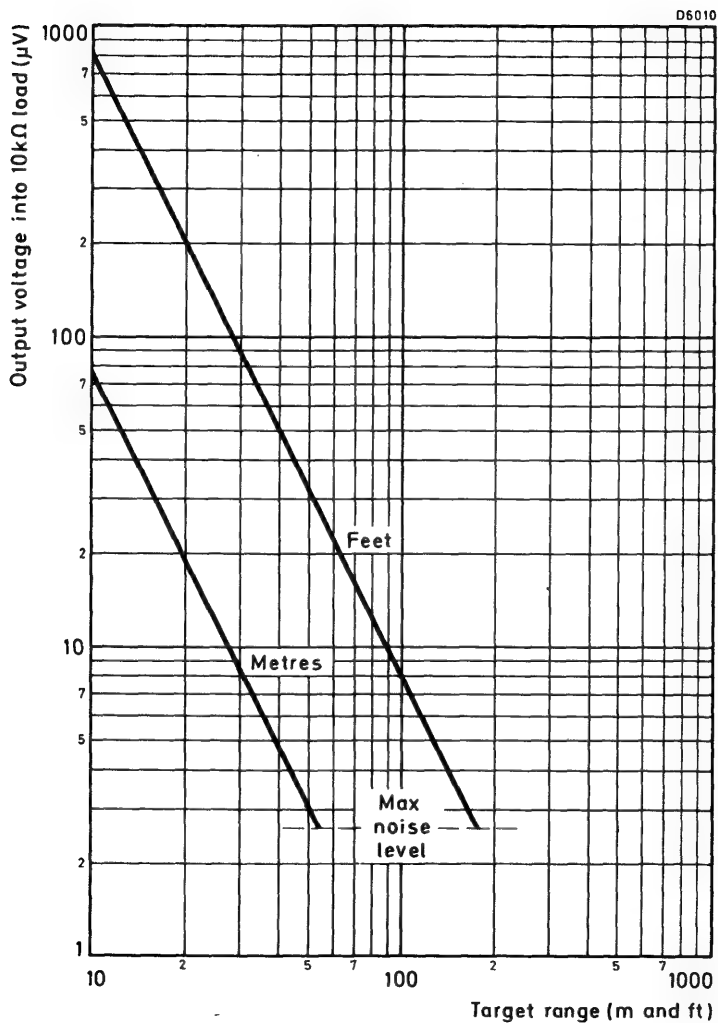
Gunn device characteristic



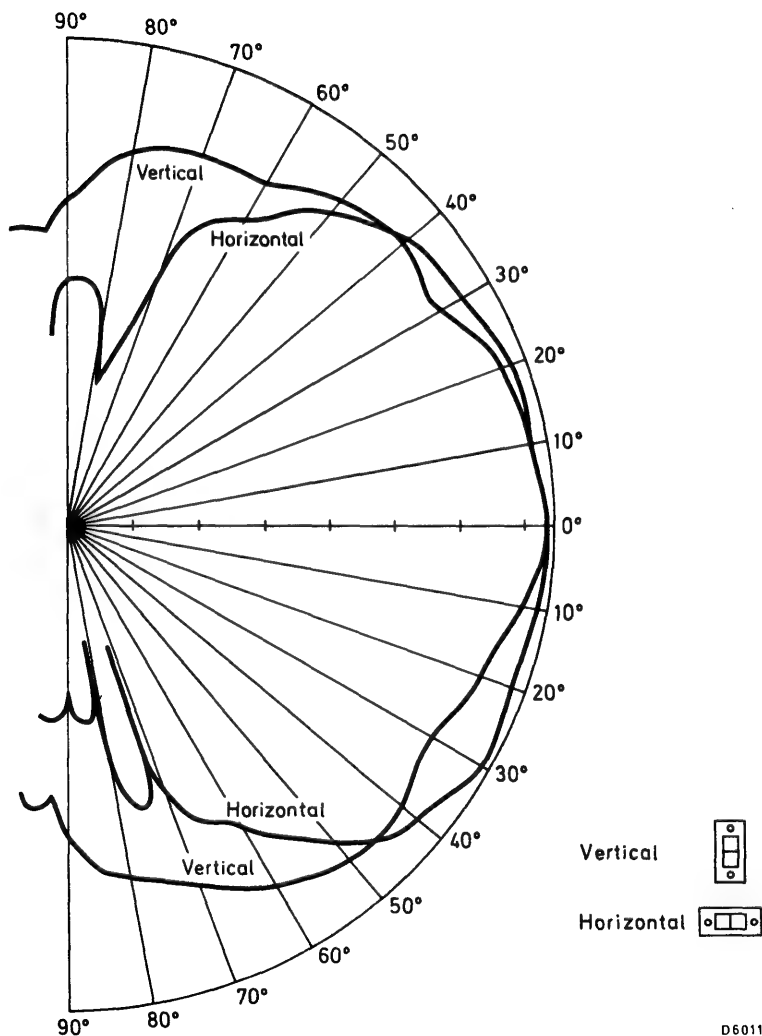
Circuit used to measure A.F. performance

Notes

1. The current I_b should be approximately $35\mu A$ with the Gunn device disconnected and approximately $42\mu A$ with the Gunn device operational and the antenna operating into free space.
2. The coupling capacitor should have a small impedance compared with Z_{in} .



Minimum output for a man target



Polar diagram for antenna supplied

MODULE MOUNTING

For optimum signal to noise ratio, it is recommended that the module and antenna are mounted, using M4 screws, to a 1.6mm thick metal plate with aperture dimensions as shown on page 9.

In this configuration, the metal plate forms the front panel of the equipment, and the antenna radiates into free space. If the equipment housing is all metal, any back radiation will be totally contained. Alternatively a metal based adhesive tape may be used to seal the joint between antenna and mounting plate.

The total mixer bias under the optimum operating conditions is approximately $42\mu\text{A}$. ($35\mu\text{A}$ d.c. bias + $7\mu\text{A}$ from -19dBm of coupled l.o. power.)

If, however, for environmental reasons, it is considered desirable to cover the antenna aperture, then it is recommended that a thin plastic material (approximately 0.25mm thick) is fixed to the metal plate with adhesive. A suitable plastic material is detailed on page 9.

In this case, the l.o. power coupled to the mixer will be -11dBm, and the total mixer bias current will now be approximately $60\mu\text{A}$.

The increase in l.o. power will, in general give rise to an increase in a.f. output voltage for a given target, but this will be accompanied by a degradation in signal to noise ratio. For -11dBm of l.o. power, the degradation in signal to noise ratio should be acceptable for most applications.

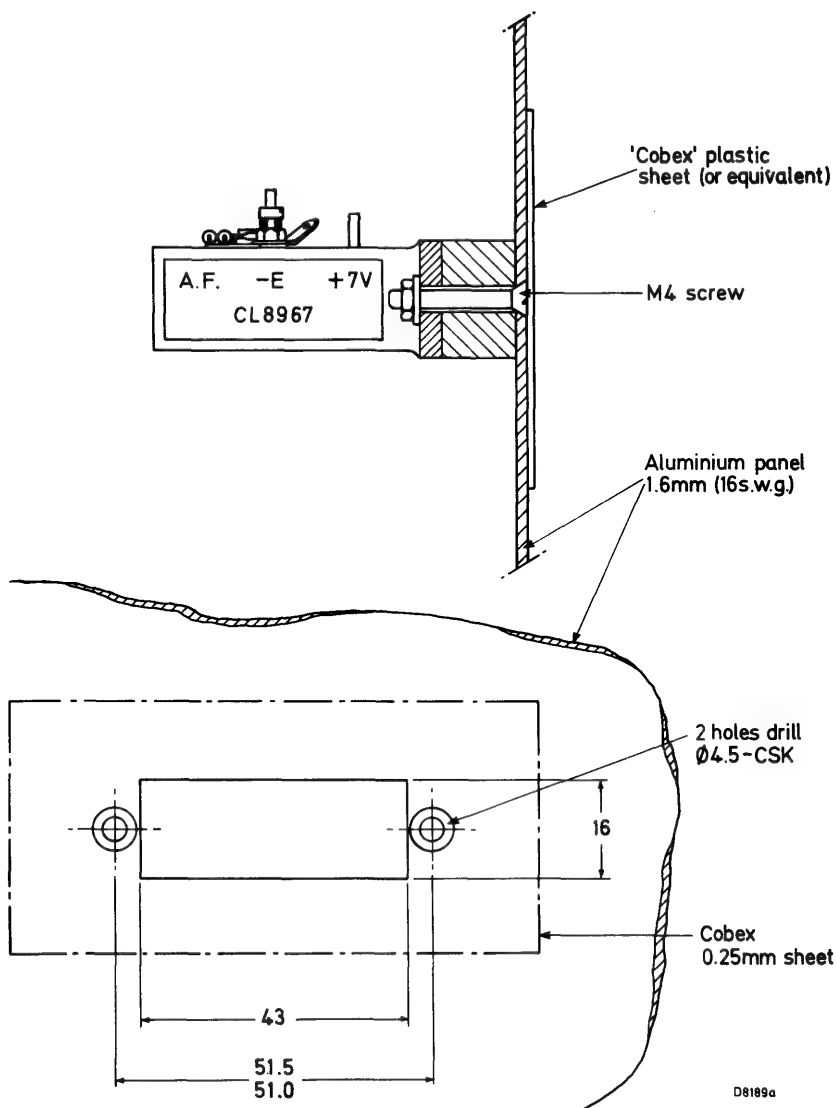
However, further increase in the level of coupled l.o. power arising from the use of thick or 'microwave' reflective covering materials, will:

- (a) continue to increase the a.f. output voltage from the mixer (N.B. the increase will not be the same for all modules) but at the same time, degrade the signal to noise ratio.
- (b) present a mismatch to the Gunn oscillator which may impair the switching and running performance and may 'pull' the frequency outside the allocated operating frequency band.

The following table compares the l.o. coupling level obtained for different covering materials at the antenna.

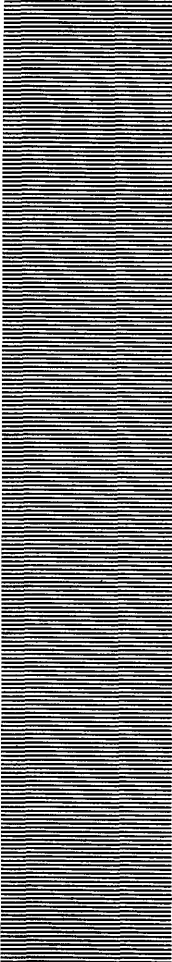
| L. O. coupling (dBm) | Mixer total bias (μA) | Antenna covering material |
|-------------------------|---------------------------------------|--|
| - | 35 (d.c. only) | - |
| -19 | 42 | No covering |
| -15 | 50 | 1 to 2cm expanded polythene or polystyrene |
| -11 | 61 | 0.25mm Cobex plastic |
| -6 | 70 | 0.5mm Cobex plastic |

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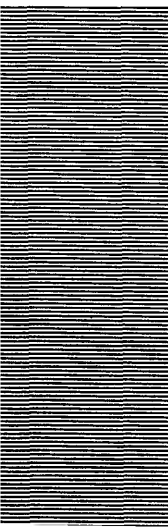


MISCELLANEOUS

H



H



MICROWAVE HORN ANTENNA

ACX-01A

TENTATIVE DATA

A general purpose X-band antenna for miniature radar systems.
The unit gives a low v.s.w.r. and is of a strong cast construction.

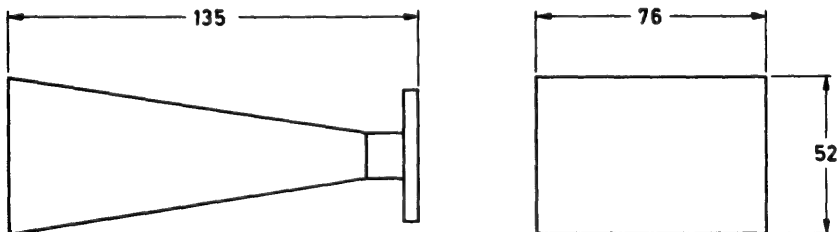
CHARACTERISTICS

| | | |
|--------------------------|-----------|-----|
| Frequency range | 9.0 to 11 | GHz |
| Gain | 16 | dB |
| Beam angle (both planes) | 30 | deg |
| v.s.w.r. max. | 1.2 | |

MECHANICAL DATA

| | | |
|--------|------------------|---|
| Weight | 160 | g |
| Flange | UBR100 (UG135/U) | |

OUTLINE DRAWING



All dimensions in mm

D6006

X-BAND MIXER/DETECTOR

CL7500

Waveguide single ended mixer designed for use in the 10.7 GHz band. It is primarily intended for Doppler control systems, e.g. intruder alarms deriving local oscillator drive from the transmitter output of a Gunn effect device such as Mullard CL8630. The CL7500 can be used as a microwave detector. Two examples of this are sensing deliberate beam obstruction in a microwave protected area and as receiver in a microwave barrier or fence.

QUICK REFERENCE DATA

| | | |
|--|--------|---------------|
| Centre frequency | 10.687 | GHz |
| Typical sensitivity for -95 dBm input | 15 | μV |
| Typical noise level (32 μA d.c. bias, 1 Hz to 1 kHz bandwidth) | 1.0 | μV |

LIMITING VALUES (Absolute max. rating system)

| | | |
|--------------------------------------|-------------|--------------------|
| I_R (max.) | 5.0 | mA |
| I_{FM} peak forward current (max.) | 10 | mA |
| T_{stg} range | -10 to +100 | $^{\circ}\text{C}$ |

TYPICAL OPERATING CONDITIONS

| | | |
|----------------------------|------------|--------------------|
| T_{amb} range | -10 to +50 | $^{\circ}\text{C}$ |
| Local oscillator level | -18 | dBm |
| D.C. bias | 32 | μA |
| Total load (d.c. and i.f.) | 10 | k Ω |

ELECTRICAL CHARACTERISTICS (at 25 $^{\circ}\text{C}$)

| | | |
|------------------|--------|-----|
| Centre frequency | 10.687 | GHz |
|------------------|--------|-----|

Mixer

| | | | |
|--|------|-----|---------------|
| Sensitivity for -95 dBm input | min. | 10 | μV |
| | typ. | 15 | μV |
| Noise level (32 μA d.c. bias, 1 Hz to 1 kHz bandwidth) ¹⁾ | typ. | 1.0 | μV |
| | max. | 2.0 | μV |

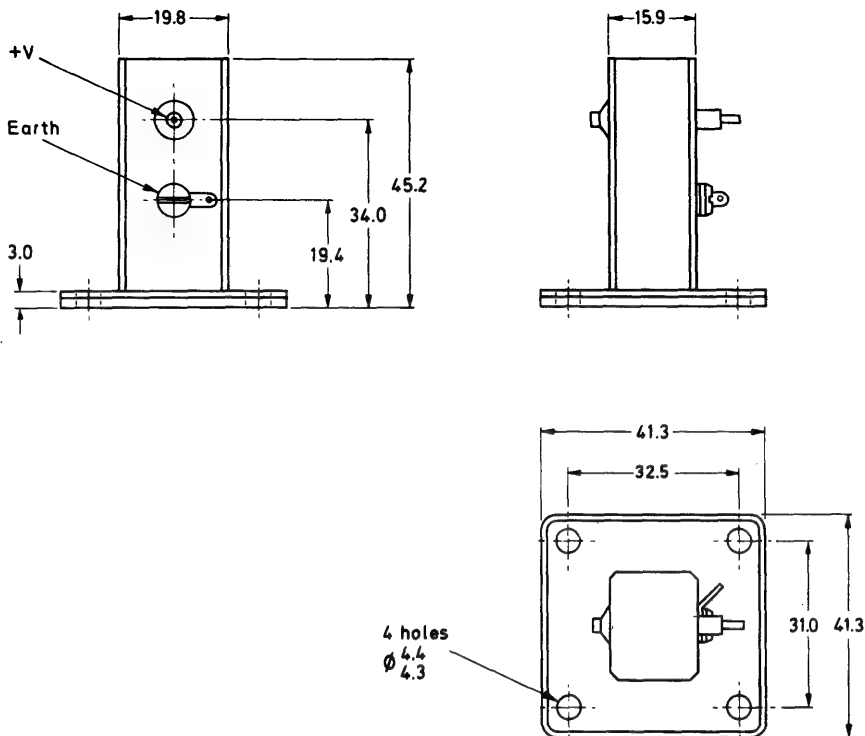
Detector

| | | | |
|--|------|-----|-----|
| Tangential sensitivity at centre frequency ²⁾ | typ. | -50 | dBm |
| Tangential sensitivity from 10.1 to 11.0 GHz ²⁾ | typ. | -49 | dBm |

Notes see page 2

Mullard

OUTLINE DRAWING



All dimensions in mm

D5835a

- 1) When the local oscillator power is derived from a Gunn source with an a.m. noise to carrier ratio of 94 dB (typically Mullard CL8630), the minimum sensitivity specified represents a signal to noise ratio at the mixer output of 10 dB (typically 17 dB).
- 2) When operated as a detector with 32 μ A d.c. bias, measured in a 0 to 2 MHz bandwidth.
- 3) The diode may be damaged if the bias supply is reversed.
- 4) The mixer diode will be damaged by forward current in excess of 10 mA. The module is supplied with a shorting strap connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from mains supplies and that the shorting strap is not removed until all wiring has been completed.
- 5) Connections to be made to W.G. 16 components.

X-BAND MIXER/DETECTOR

CL7520

Waveguide single ended mixer designed for use in the 9.35 GHz band. It is primarily intended for Doppler control systems, e.g. intruder alarms deriving local oscillator drive from the transmitter output of a Gunn effect device such as Mullard CL8631 or CL8632. ←

The CL7520 can be used as a microwave detector. Two examples of this are sensing deliberate beam obstruction in a microwave protected area and as receiver in a microwave barrier or fence.

QUICK REFERENCE DATA

| | | |
|---|------|-----|
| Centre frequency | 9.35 | GHz |
| Typical sensitivity for -95 dBm input | 15 | μV |
| Typical noise level (32 μA d.c. bias, 1 Hz to 1 kHz bandwidth) | 1.0 | μV |

LIMITING VALUES (Absolute max. rating system)

| | | |
|---|-------------|----|
| I _R (max.) | 5.0 | mA |
| I _{FM} peak forward current (max.) | 10 | mA |
| T _{stg} range | -10 to +100 | °C |

TYPICAL OPERATING CONDITIONS

| | | |
|----------------------------|------------|-----|
| T _{amb} range | -10 to +50 | °C |
| Local oscillator level | -18 | dBm |
| D. C. bias | 32 | μA |
| Total load (d.c. and i.f.) | 10 | kΩ |

ELECTRICAL CHARACTERISTICS (at 25 °C)

| | | |
|------------------|------|-----|
| Centre frequency | 9.35 | GHz |
|------------------|------|-----|

Mixer

| | | | |
|---|------|-----|----|
| Sensitivity for -95 dBm input | min. | 10 | μV |
| | typ. | 15 | μV |
| Noise level (32 μA d.c. bias, 1 Hz to 1 kHz bandwidth) ¹⁾ | typ. | 1.0 | μV |
| | max. | 2.0 | μV |

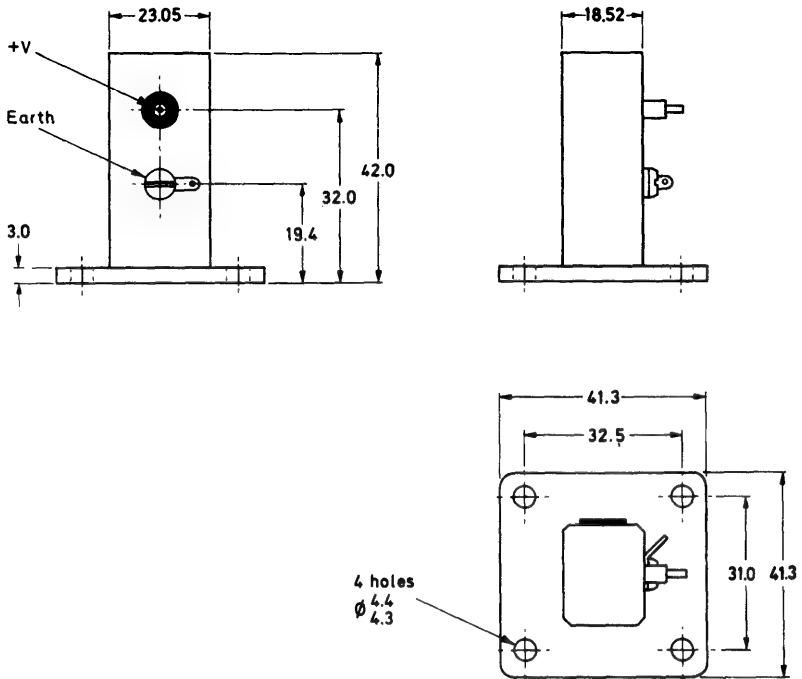
Detector

| | | | |
|--------------------------------------|------|----|-----|
| Tangential sensitivity ²⁾ | typ. | 50 | dBm |
|--------------------------------------|------|----|-----|

Notes see page 2

Mullard

OUTLINE DRAWING



All dimensions in mm

D8214a

- 1) When the local oscillator power is derived from a Gunn source with an a.m. noise to carrier ratio of 94 dB (typically Mullard CL8631 or CL8632), the minimum sensitivity specified represents a signal to noise ratio at the mixer output of 10 dB (typically 14 dB).
- 2) When operated as a detector with 32 μ A d.c. bias, measured in a 0 to 2 MHz bandwidth.
- 3) The diode may be damaged if the bias supply is reversed.
- 4) The mixer diode will be damaged by forward current in excess of 10 mA. The module is supplied with a shorting strap connected between the mixer a.f. and earth terminals. The mixer has a low junction capacitance and may be damaged by transients of very short duration. It is therefore recommended that soldering irons are isolated from main supplies and that the shorting strap is not removed until all wiring has been completed.
- 5) Connections to be made to W.G. 16 components.

PARAMETRIC AMPLIFIER

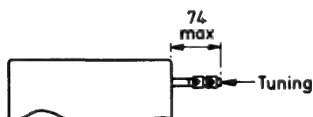
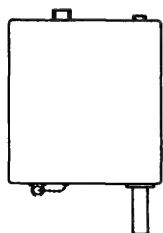
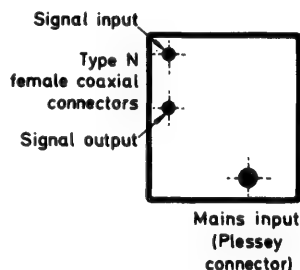
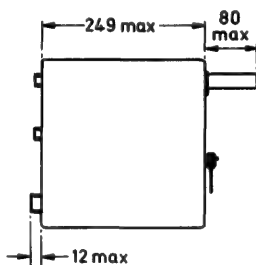
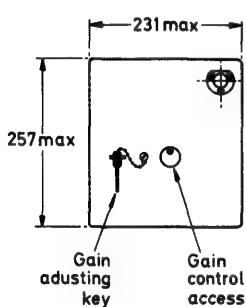
A single-diode non-degenerate parametric amplifier designed for use as a low-noise pre-amplifier in microwave applications. It is supplied in a temperature stabilized enclosure with a solid state Gunn-effect oscillator pump and integral power supply.

QUICK REFERENCE DATA

| | | |
|----------------------------|------------------|----------|
| Power gain | 20 | dB |
| Tuning range min. | 2.7 to 3.1 | GHz |
| Noise figure max. | 2.8 | dB |
| Bandwidth | 15 | MHz |
| Input and output impedance | 50 | Ω |
| Mains supply | 240 V, 2A, 50 Hz | |

MECHANICAL DATA

Dimensions in mm



Part view showing micrometer guard removed

D6574



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

| | | | |
|-------------------------------------|------|------------|-----------------|
| Continuous r.f. input power | max. | 100 | mW |
| Input spike energy | max. | 500 | nJ |
| Mains supply voltage | max. | 276 | V _{ac} |
| Ambient operating temperature range | | -20 to +55 | °C |
| Storage temperature range | | -30 to +70 | °C |

CHARACTERISTICS (note 1)T_{amb} = 25 °C

| | min. | typ. | max. | |
|---|------|------|------|-----------------|
| Power gain (recommended setting) (note 2) | — | 20 | — | dB |
| Operating frequency | 2.7 | — | 3.1 | GHz |
| Noise figure | — | 2.6 | 2.8 | dB |
| Bandwidth (note 3) | 12 | — | 18 | MHz |
| Input saturation level (note 4) | -35 | -32 | — | dBm |
| Gain stability per hour | | ±0.1 | | dB |
| per day | | ±0.5 | | dB |
| Mains voltage supply limits | 204 | 240 | 276 | V _{ac} |
| MASS | | 5.4 | | kg |

Notes

1. These are given for matched conditions.
2. The gain-set attenuator is adjusted with the hexagonal key provided.
3. Measured to the 3 dB points at a gain setting of 20 dB.
4. This is the input level at which the gain is compressed by 1 dB, at a gain setting of 20 dB.
5. The amplifier is designed for ease of maintenance; both the temperature control system and the Gunn oscillator power supply use field-replaceable plug-in boards.

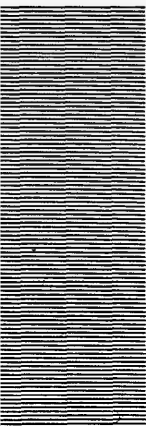


ISOLATORS AND CIRCULATORS

J



J



ISOLATORS AND CIRCULATORS

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ISOLATORS AND CIRCULATORS

INTRODUCTION

Only a brief general description of isolators and circulators is given here: those readers seeking fuller information are referred to our Application Book *'Isolators and Circulators'*.

Isolators

An isolator is a passive non-reciprocal device which permits microwave energy to pass through it in one direction whilst absorbing energy in the reverse direction. In the forward direction, that is the direction in which the energy is passed, the insertion loss is usually 0.3 to 0.5 dB in the frequency range for which the isolator has been designed. In the opposite direction the isolation is normally 30 dB but for certain applications isolation can be made as high as 55 to 60 dB.

In the field displacement type of isolator, which is described later, a ferrite bar is mounted in a waveguide and biased by a magnetic field. The non-reciprocal behaviour of this type of isolator is produced by gyromagnetic effects which occur between the high frequency magnetic field and the electrons in the ferrite.

Circulators

A circulator is a passive non-reciprocal device with three or more ports. It contains a core of ferrite material in which energy introduced into one port is transferred to an adjacent port, the other ports being isolated.

Although circulators can be made with any number of ports, the most commonly used are 3-port and 4-port, the symbols for which are given in Figs 1 and 2.

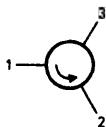


Fig. 1 Symbol for 3-port circulator.

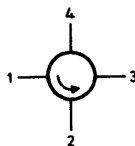


Fig. 2 Symbol for 4-port circulator.

Energy entering port 1 emerges from port 2; energy entering port 2 emerges from port 3, and so on in cyclic order. In this direction of circulation an ideal circulator would have no losses, but in practical constructions there are some losses.

In an ideal circulator no energy would flow in the direction opposite to the circulation direction. Again in practice this isolation is in the order of 20 to 30 dB; in very narrow bands it is even higher. The non-reciprocal behaviour of circulators is the result of gyromagnetic effects in the ferrite when this is biased with a magnetic field.

APPLICATIONS

Isolators

The main application of an isolator is to improve the behaviour of klystrons, magnetrons or travelling-wave tubes by isolating the source from the load. The main factor is that an antenna or amplifier cannot be matched ideally to the preceding function over the required frequency range, so that energy would be reflected back into the tube and upset the frequency stability. The isolator will absorb this reflected energy so that the tube is effectively protected from these disturbing influences.

The isolators are provided with adjusting screws that enable them to be matched so that the v.s.w.r. is minimum over a certain frequency range. It is therefore possible to optimize the efficiency of wave-guide runs by matching the isolator to minimum reflection. This means that long line effects can be drastically reduced.

Circulators

The main application of circulators is the duplexing of systems for simultaneous transmission and reception in low and medium-power telecommunication equipment; this is illustrated in Figs 3 and 4.

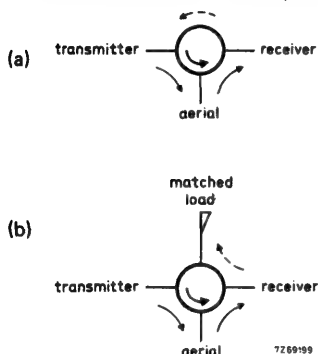


Fig. 3 Duplexing one receiver and one transmitter with (a) a 3-port circulator and (b) a 4-port.

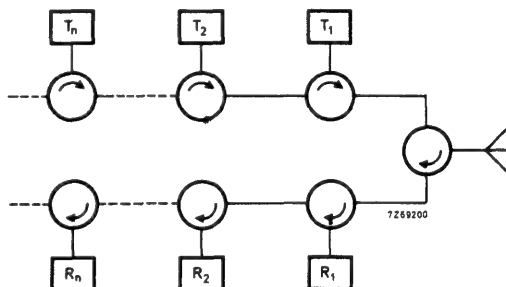


Fig. 4 Duplexing of a number of transmitters (T) and receivers (R).

The reasons that both 3-port and 4-port circulators are used are:

- a 3-port circulator usually has a wider bandwidth than a 4-port circulator;
- a 4-port circulator (of which the fourth port is provided with a matched load, Fig. 3(b)), however, does not require a very accurately matched receiver, so that a much simpler filter can be used on the receiver input.

A 3-port circulator can also be used as an isolator by putting a matched load on one port; Fig. 5. The characteristics of a circulator performing a decoupling function are superior to those of an isolator, particularly at the lower frequencies. Decoupling can be increased by cascading circulators. Decoupling and insertion loss are directly proportional to the number of circulators. For additional information refer to our Application Book *'Isolators and Circulators'*.



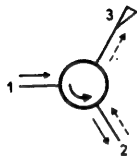


Fig. 5 A 3-port circulator used as an isolator.

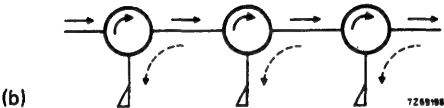
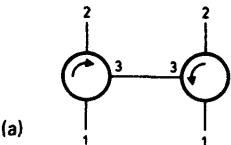


Fig. 6 Cascaded circulators (a) in H-configuration, (b) π -configuration.

CONSTRUCTION

Waveguide isolators

A field displacement isolator is shown in Fig. 7. The ferrite bar (1) can be seen inside the waveguide, flanked by two sets of magnets (2) outside the waveguide. These magnets bias the ferrite bar. The adjusting screws (3) protruding into the waveguide are used to match the isolator for minimum voltage standing wave ratio.

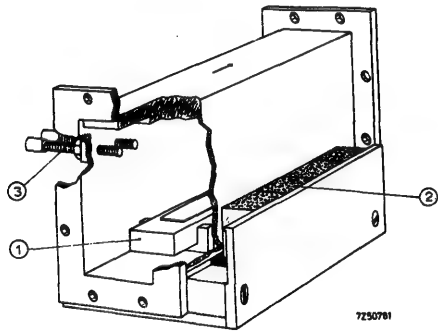


Fig. 7 Field displacement isolator.

Waveguide circulators

Three or four waveguides intersect at angles of 120° or 90° respectively in this type of circulator. A 4-port waveguide circulator of the junction type is shown in Fig. 8. A piece of ferrite (1) is located between two magnets (2) exactly in the centre of the intersection. Posts (3) are placed in the waveguide to achieve a good match.



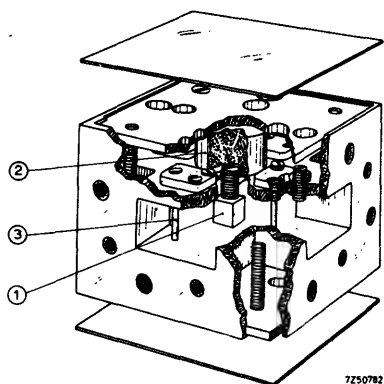


Fig. 8 Construction of a junction type waveguide circulator.

Coaxial circulators

A coaxial circulator of the junction type is shown in Fig. 9. Three copper strips (1) intersect at 120° in the centre of the circulator. The strips are mounted between two earth plates (2) to form a matched high-frequency conductor. Two ferrite discs (3) and magnets (4) are mounted in the exact centre of the circulator.

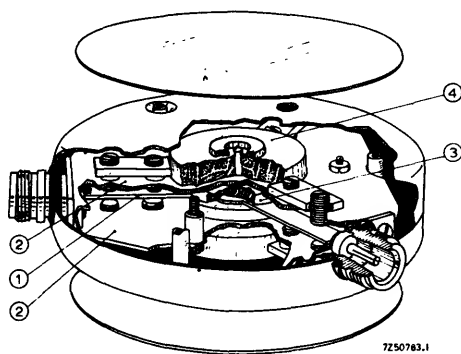


Fig. 9 Construction of a junction type coaxial circulator.

TERMS AND DEFINITIONS

Frequency range

This is the range within which the isolator or circulator meets the guaranteed specification. Outside of this range the electrical properties deteriorate rapidly. Circulators, however, will not be damaged if erroneously subjected to frequencies outside the range.

Isolation

In an *isolator*, isolation is the ratio of the input power to the output power in the reverse direction, expressed in dB. The power measurements are made with matched source and matched load.

In a *circulator*, isolation is the ratio of the energy entering a port to the energy scattered into the adjacent port in the reverse direction to normal circulation, expressed in dB. Measurements are made with a matched source and all other ports correctly terminated. The isolation between ports 1 and 3, α_{1-3} , is equal to α_{3-2} and α_{2-1} (Fig. 1).

Insertion loss

This is the attenuation which results from including an isolator or circulator in the transmission system. Insertion loss is the proportion of power lost between the ports of the device when energy is travelling in the forward direction, expressed in dB. Measurements are made with the input and output matched.

Voltage standing wave ratio

The v.s.w.r. is the ratio of the maximum voltage to the minimum voltage along a lossless line. In circulators the v.s.w.r. is measured with all unused ports terminated by a matched load. Coaxial circulators are designed with a characteristic impedance of 50 ohms.

Maximum power

Under no circumstances should the maximum power value for isolators and circulators be exceeded.

In an *isolator*, the maximum power is the largest power that may be passed through it in the forward direction into a load with a v.s.w.r. of 2.

In a *circulator*, the maximum power is the largest power that it can handle at sea level and maximum ambient temperature — and with cooling applied if specified in the data — when one port is terminated with a mismatch having a v.s.w.r. of 2, and the next port is matched having a v.s.w.r. ≤ 1.2 .

The maximum power for coaxial circulators is the maximum continuous-wave power unless a maximum peak power is separately stated. These power levels should not be exceeded.

The peak power is the maximum peak sync power as defined by the CCIR signal standard. This value is given for isolators and circulators at the v.h.f. and u.h.f. television frequencies. If this value is exceeded the isolator or circulator can be damaged by arcing in its internal transmission structure.

Peak power values are valid for one signal passage only.

Since the sound power P_s passes through the circulator twice in a signal-combining circulator, the average power when $P_s = 0.2P_{\text{sync}}$ is given by $P \approx 1.17P_{\text{sync}}$.

Under worst-case conditions, the peak power produced for the same signal is given by

$$P_M = \sqrt{P_{\text{sync}}} + 2\sqrt{P_s} = P_{\text{sync}} (1 + 2\sqrt{0.2})^2 = 3.6P_{\text{sync}}$$

Temperature range

The ambient temperature range within which isolators and circulators function to specification. (When necessary, special temperature compensation is built in for circulators.) Circulators still function outside the temperature range but their electrical behaviour may be far outside the guaranteed specifications. However, no permanent damage can be expected unless a large temperature rise is caused by excessive power handling.

The storage temperature of isolators may be from -40 to $+125$ °C unless otherwise specified in the data.



CAUTIONARY NOTES

1. Isolators and circulators have internal magnetic fields that are carefully adjusted for optimum operation.
2. Isolators and circulators are not to be subjected to strong external magnetic fields.

QUALITY GUARANTEE

Subject to the Conditions of Guarantee the Manufacturer guarantees the isolators/circulators supplied to the purchaser to meet the specifications as published in the Manufacturer's Data Handbook and to be free from defects in material and workmanship.

Under this guarantee the Manufacturer will within one year after shipment to the original purchaser repair or replace at the Manufacturer's option, free of charge, any isolator/circulator proved by the Manufacturer's inspection to be thus defective.

STANDARD TEST SPECIFICATIONS

Initial measurements

These measurements have been carried out at room temperature and at the extreme temperatures, with a power level not exceeding 10 mW.

Tropical test

This test has been carried out completely in accordance with IEC 68 test D, accelerated damp heat. This test begins with the temperature at $55 \pm 2^\circ\text{C}$ and R.H. at 95 to 100% for a period of 16 hours, followed by a period of 8 hours with the temperature at $+25^\circ\text{C}$ and R.H. 80 to 100% to complete the 24-hour cycle: the test consists of 6 uninterrupted cycles.

Vibration test

This test has been carried out completely in accordance with MIL-STD-202D, method 201A: frequency range 10 to 55 to 10 Hz for 2 hours in each of the X, Y and Z directions, with a total excursion of 1,5 mm.

Thermal shock test

This test has been carried out completely in accordance with MIL-STD-202D, method 107C under condition A: 5 cycles with extreme temperatures of -55°C and $+85^\circ\text{C}$; duration of one cycle is 1 hour.

Mechanical shock test

This test has been carried out in accordance with MIL-STD-202D, method 213A under condition G: peak value 100 g, duration 6 ms, and also with extreme peak values up to 800 g, duration approximately 1 ms for each device, referring to the results of the drop test.

Drop test

This test has been carried out in accordance with ISO 2248, part IV: packaging complete, filled transport packages, vertical impact.

R.F. power test

The devices have been tested in accordance with the definition of maximum power in the Data Handbook (v.s.w.r. = 2). The ambient temperature of 25°C was increased to the maximum operating temperature and the duration of the test was 1 hour for each device.



Final measurements

On completion of the above tests final measurements were carried out at a temperature of + 25 °C and with a power level not exceeding 10 mW. The results of these tests should be within the guaranteed values.

Dimensions and visual appearance

These have been checked in accordance with the published data.

Note

On request, different tests and/or additional tests to those above can be carried out.



COAXIAL CIRCULATOR SERIES, BANDS IV-V, 100 W, U.H.F., TV

| frequency range | isolation dB | | insertion loss dB | | v.s.w.r. | | max. power W | | temperature range | connector type | mass approx | catalogue number |
|--------------------|-----------------|-----|----------------------|------|-----------------|------|-----------------|--------------|----------------------|-------------------|----------------|---------------------|
| | guaran- teed | typ | guaran- teed | typ | guaran- teed | typ | c.w. | peak sync | | | | |
| MHz | | | | | | | | | °C | * | g | |
| 400-470 | > 20 | 25 | < 0,5 | 0,35 | < 1,25 | 1,15 | 100 | 200 | -10 to + 60 | N-female | 400 | 2722 162 03411 |
| 470-600 | > 20 | 25 | < 0,5 | 0,35 | < 1,25 | 1,15 | 100 | 200 | -10 to + 60 | N-female | 400 | 2722 162 01551 |
| 600-800 | > 20 | 25 | < 0,5 | 0,35 | < 1,25 | 1,15 | 100 | 200 | -10 to + 60 | N-female | 400 | 2722 162 01561 |
| 790-1000 | > 20 | 25 | < 0,5 | 0,3 | < 1,25 | 1,14 | 100 | 200 | -10 to + 60 | N-female | 400 | 2722 162 03261 |

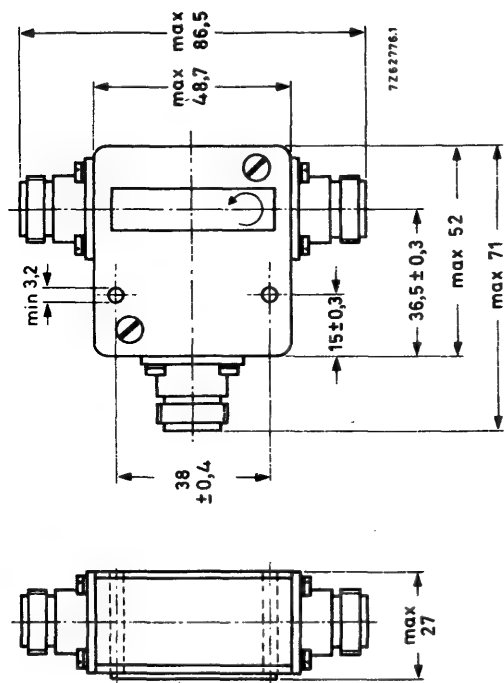
Notes

Combinations to form 4-port versions (π or H configurations) can be made to special order.
Isolator versions of these circulators are available.

* These circulators can be made available with different connector types.



Dimensions in mm



2722 162 03411
01551
01561
03261

OUTLINES



Mullard

COAXIAL CIRCULATOR SERIES, 300 W, U.H.F., TV

| frequency range MHz | isolation dB | | insertion loss dB | | v.s.w.r. | | max. power W | | temperature range °C | connector type * | mass approx g | catalogue number |
|-------------------------------|-----------------|-----|----------------------|------|-----------------|------|-----------------|--------------|--------------------------------|----------------------------|-------------------------|---------------------|
| | guaran- teed | typ | guaran- teed | typ | guaran- teed | typ | c.w. | peak sync | | | | |
| 400-470 | > 20 | 25 | < 0,35 | 0,20 | < 1,25 | 1,15 | 300 | 500 | -10 to + 60 | N-female | 1200 | 2722 162 01572 |
| 400-470 | > 20 | 25 | < 0,35 | 0,20 | < 1,25 | 1,15 | 300 | 500 | -10 to + 60 | HF 7/16 | 1200 | 2722 162 01622 |
| 470-600 | > 20 | 25 | < 0,35 | 0,20 | < 1,25 | 1,15 | 300 | 500 | -10 to + 60 | N-female | 1200 | 2722 162 01582 |
| 470-600 | > 20 | 25 | < 0,35 | 0,20 | < 1,25 | 1,15 | 300 | 500 | -10 to + 60 | HF 7/16 | 1200 | 2722 162 01632 |
| 590-720 | > 20 | 25 | < 0,35 | 0,20 | < 1,25 | 1,15 | 300 | 500 | -10 to + 60 | N-female | 1200 | 2722 162 01592 |
| 590-720 | > 20 | 25 | < 0,35 | 0,20 | < 1,25 | 1,15 | 300 | 500 | -10 to + 60 | HF 7/16 | 1200 | 2722 162 01642 |
| 710-860 | > 20 | 25 | < 0,35 | 0,20 | < 1,25 | 1,15 | 300 | 500 | -10 to + 60 | N-female | 1200 | 2722 162 01612 |
| 710-860 | > 20 | 25 | < 0,35 | 0,20 | < 1,25 | 1,15 | 300 | 500 | -10 to + 60 | HF 7/16 | 1200 | 2722 162 01662 |

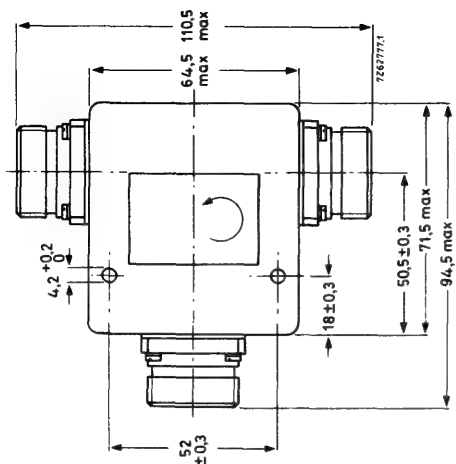
Note

Isolator versions of these circulators are available.

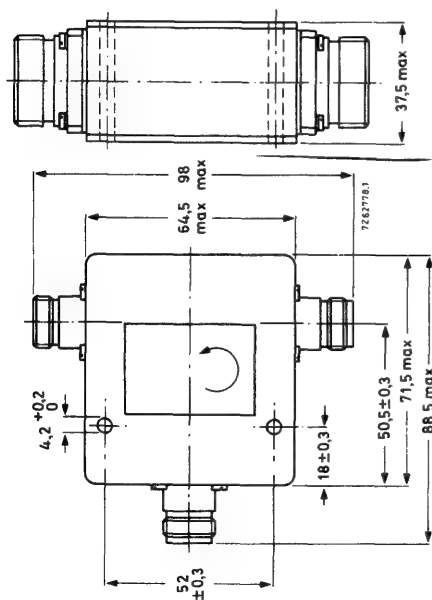
* These circulators can be made available with different connector types.



Dimensions in mm

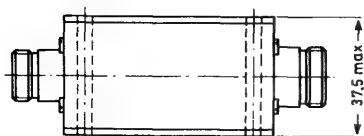


2722 162 01622
01632
01642
01662



2722 162 01572
01582
01592
01612

OUTLINES



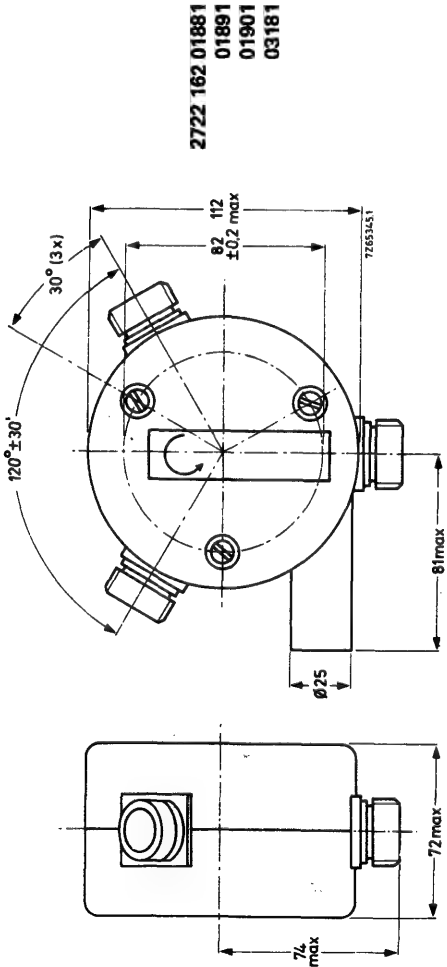
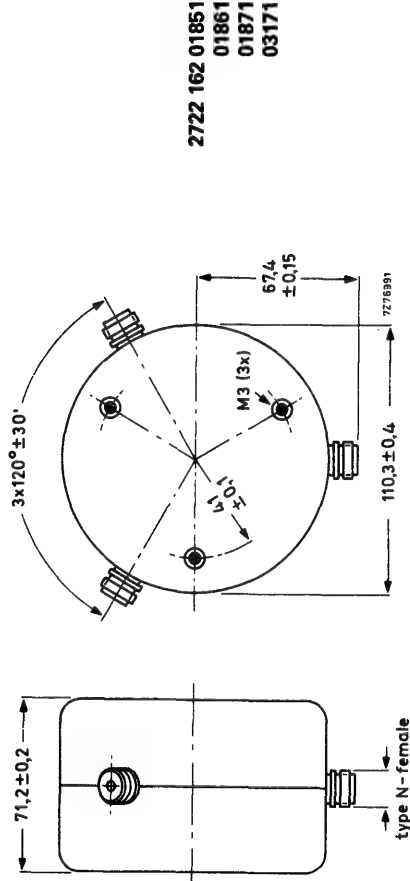
COAXIAL CIRCULATOR SERIES, 500 W/1 kW, V.H.F., TV

| frequency range | isolation dB | | insertion loss dB | | v.s.w.r. | | max. power W | | temperature range | connector type | mass approx g | catalogue number |
|--------------------|-----------------|-----|----------------------|-----|-----------------|------|-----------------|--------------|----------------------|-------------------|---------------------|---------------------|
| | guaran- teed | typ | guaran- teed | typ | guaran- teed | typ | c.w. | peak sync | | | | |
| 160-178 MHz | > 20 | 24 | < 0,35 | 0,3 | < 1,25 | 1,15 | 500 | 850 | -10 to + 60 | N-female | 2100 | 2722 162 01871 |
| 160-178 | > 20 | 24 | < 0,35 | 0,3 | < 1,25 | 1,15 | 1000 | 1800 | -10 to + 40* | HF 7/16 | 2150 | 2722 162 01901 |
| 173-204 | > 20 | 24 | < 0,35 | 0,3 | < 1,25 | 1,15 | 500 | 850 | -10 to + 60 | N-female | 2100 | 2722 162 01861 |
| 173-204 | > 20 | 24 | < 0,35 | 0,3 | < 1,25 | 1,15 | 1000 | 1800 | -10 to + 40* | HF 7/16 | 2150 | 2722 162 01891 |
| 200-230 | > 20 | 24 | < 0,35 | 0,3 | < 1,25 | 1,15 | 500 | 850 | -10 to + 60 | N-female | 2100 | 2722 162 01851 |
| 200-230 | > 20 | 24 | < 0,35 | 0,3 | < 1,25 | 1,15 | 1000 | 1800 | -10 to + 40* | HF 7/16 | 2150 | 2722 162 01881 |
| 225-270 | > 20 | 24 | < 0,35 | 0,3 | < 1,25 | 1,15 | 500 | 850 | -10 to + 60 | N-female | 2100 | 2722 162 03171 |
| 225-270 | > 20 | 24 | < 0,35 | 0,3 | < 1,25 | 1,15 | 1000 | 1800 | -10 to + 40* | HF 7/16 | 2150 | 2722 162 03181 |

* With air cooling (filtered) at a pressure of 25 mm water column and maximum 40 °C intake temperature, the permissible connector temperature is + 55 °C.



Dimensions in mm



OUTLINES



Mullard

COAXIAL CIRCULATOR SERIES, BANDS IV-V, 500 W/2 kW, U.H.F., TV

| frequency range | isolation dB | | insertion loss dB | | v.s.w.r. | | max. power W | | temperature range | connector type | mass approx | catalogue number |
|--------------------|-----------------|-----|----------------------|------|-----------------|------|-----------------|-----------------------|----------------------|-------------------|----------------|---------------------|
| | guaran- teed | typ | guaran- teed | typ | guaran- teed | typ | c.w. | c.w.+ peak sync | | | | |
| MHz | | | | | | | | | °C | | g | |
| 470-600 | > 22 | 24 | < 0,35 | 0,25 | < 1,2 | 1,15 | 500 | 900 | -10 to + 70 | N-female** | 2080 | 2722 162 01121 |
| 470-600 | > 20 | 24 | < 0,35 | 0,17 | < 1,25 | 1,12 | 2000 | 2000 | -10 to + 40* | HF 7/16 | 2000 | 2722 162 01261 |
| 590-720 | > 22 | 24 | < 0,35 | 0,25 | < 1,2 | 1,15 | 500 | 900 | -10 to + 70 | N-female** | 2080 | 2722 162 01131 |
| 590-720 | > 22 | 27 | < 0,35 | 0,15 | < 1,2 | 1,1 | 2000 | 2000 | -10 to + 40* | HF 7/16 | 2000 | 2722 162 01281 |
| 600-800 | > 20 | 24 | < 0,35 | 0,17 | < 1,25 | 1,13 | 2000 | 2000 | -10 to + 40* | HF 7/16 | 2000 | 2722 162 01331 |
| 710-860 | > 22 | 24 | < 0,35 | 0,25 | < 1,2 | 1,15 | 500 | 900 | -10 to + 70 | N-female** | 2080 | 2722 162 01141 |
| 710-860 | > 22 | 26 | < 0,35 | 0,16 | < 1,2 | 1,15 | 2000 | 2000 | -10 to + 40* | HF 7/16 | 2000 | 2722 162 01271 |

* With air cooling (filtered) at a pressure of 25 mm water column and maximum 40 °C intake temperature, the permissible connector temperature is + 60 °C.

** Also available with connector HF 7/16 (to DIN 47223), EIA 7/8, and EIA 1 5/8.

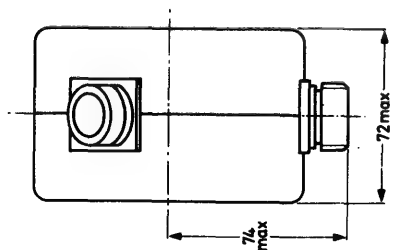
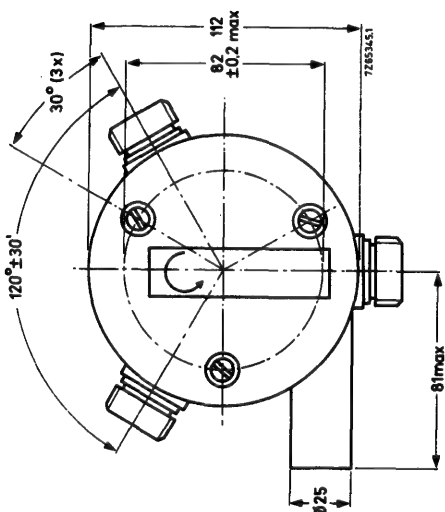
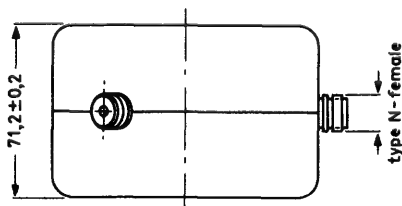
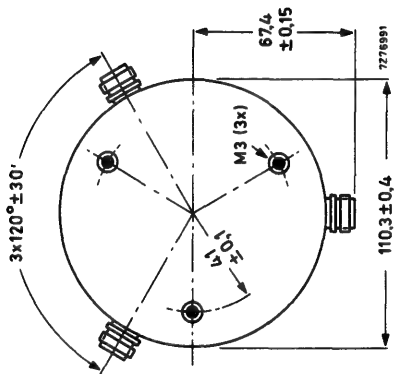


OUTLINES

Dimensions in mm

2722 162 01121
01131
01141

2722 162 01261
01271
01281
01331



COAXIAL CIRCULATOR/ISOLATOR SERIES, OCTAVE BANDWIDTH

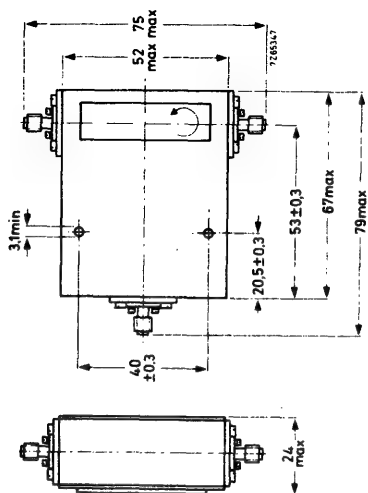
| frequency range | isolation dB | | insertion loss dB | | v.s.w.r. | | max. power W | | temperature range | connector type | mass approx | catalogue number |
|--------------------|-----------------|-----|----------------------|------|-----------------|------|-----------------|---------|----------------------|-------------------|----------------|---------------------|
| | guaran- teed | typ | guaran- teed | typ | guaran- teed | typ | forward | reverse | | | | |
| GHz | | | | | | | | | °C | | g | |
| 2-4 | > 20 | 24 | < 0,5 | 0,35 | < 1,25 | 1,15 | 50 | — | -10 to + 70 | N-female | 300 | 2722 162 01491 |
| 2-4 | > 20 | 24 | < 0,5 | 0,35 | < 1,25 | 1,15 | 50 | — | -10 to + 70 | SMA | 300 | 2722 162 01501 |
| 2-4 | > 20 | 24 | < 0,5 | 0,35 | < 1,25 | 1,1 | 50 | 5 | -10 to + 70 | N-female | 300 | 2722 162 02091 |
| 2-4 | > 20 | 24 | < 0,5 | 0,35 | < 1,25 | 1,1 | 50 | 5 | -10 to + 70 | SMA | 300 | 2722 162 02101 |
| 3-6 | > 20 | 27 | < 0,5 | 0,3 | < 1,25 | 1,1 | 20 | — | -10 to + 70 | SMA | 120 | 2722 162 01511 |
| 3-6 | > 20 | 27 | < 0,5 | 0,3 | < 1,25 | 1,1 | 20 | 5 | -10 to + 70 | SMA | 120 | 2722 162 02071 |
| 4-8 | > 20 | 23 | < 0,5 | 0,3 | < 1,25 | 1,15 | 10 | — | -10 to + 70 | SMA | 100 | 2722 162 01811 |
| 4-8 | > 20 | 27 | < 0,5 | 0,3 | < 1,25 | 1,15 | 10 | 10 | -10 to + 70 | SMA | 100 | 2722 162 02111 |
| 7-12,7 | > 20 | 23 | < 0,6 | 0,4 | < 1,25 | 1,15 | 10 | — | -10 to + 70 | SMA | 60 | 2722 162 01821 |
| 7-12,7 | > 20 | 25 | < 0,6 | 0,35 | < 1,25 | 1,12 | 10 | — | -10 to + 70 | SMA | 100 | 2722 162 02121 |
| 12-18 | > 18 | 22 | < 0,6 | 0,35 | < 1,30 | 1,2 | 5 | — | -10 to + 70 | SMA | 20 | 2722 162 03301 |
| 12-18 | > 18 | 22 | < 0,6 | 0,35 | < 1,25 | 1,2 | 5 | 1 | -10 to + 70 | SMA | 20 | 2722 162 02221 |

Note

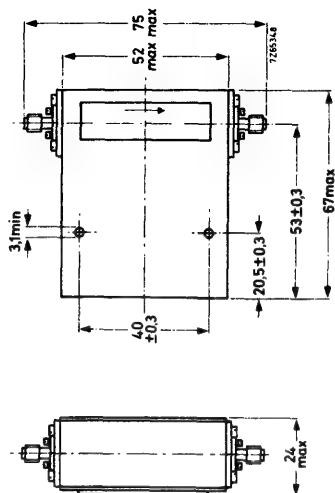
Combinations to form 4-port versions (π or H configurations) can be made to special order.



Dimensions in mm

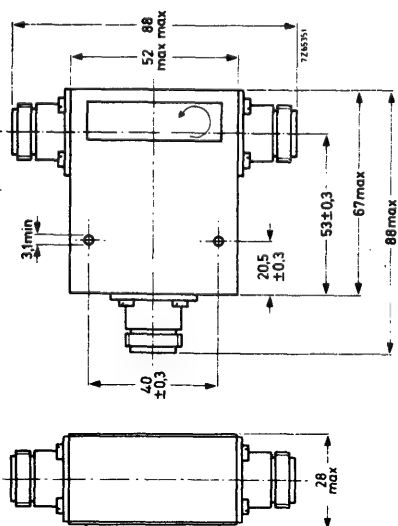


2722 162 01501

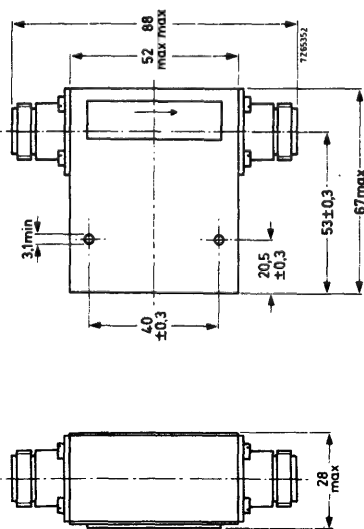


2722 162 02101

OUTLINES



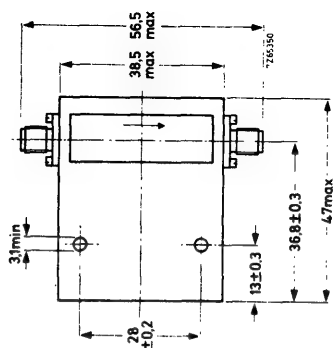
2722 162 01491



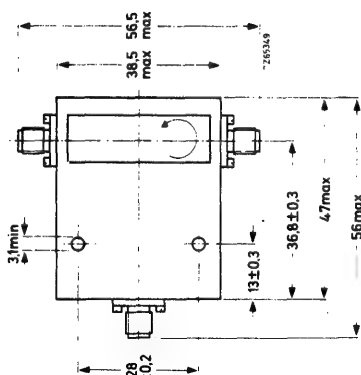
2722 162 02091



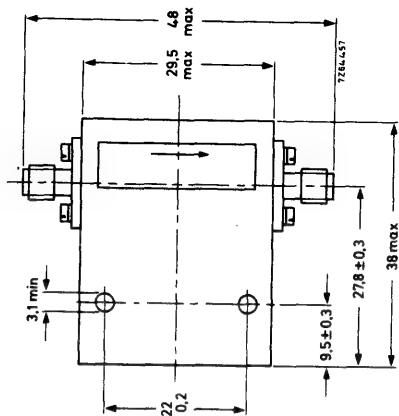
COAXIAL
CIRCULATORS/ISOLATORS,
OCTAVE BANDWIDTH



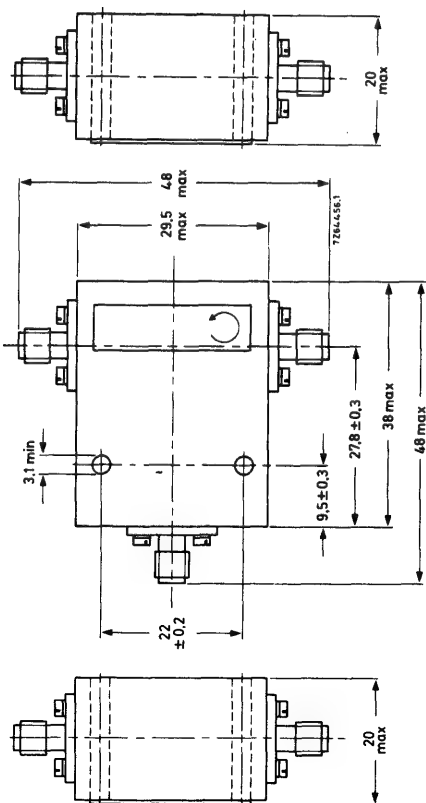
2722 162 02071



2722 162 01511

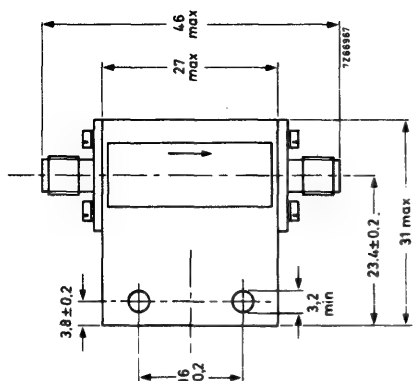


2722 162 02111

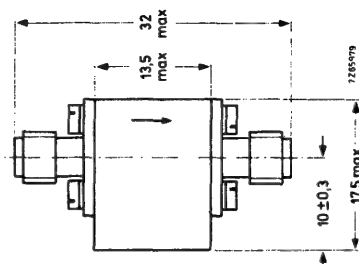


2722 162 01811

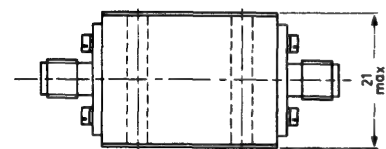




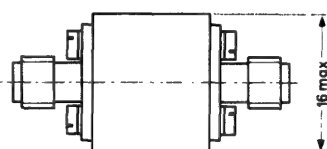
2722 162 02121



2722 162 02221



2722 162 01821



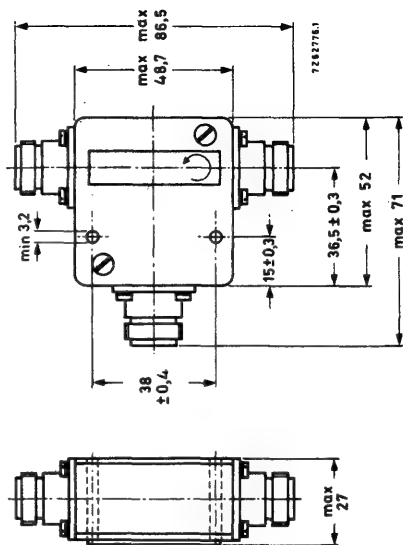
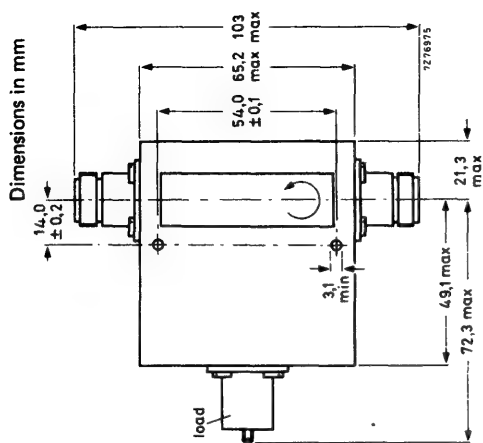
2722 162 03301



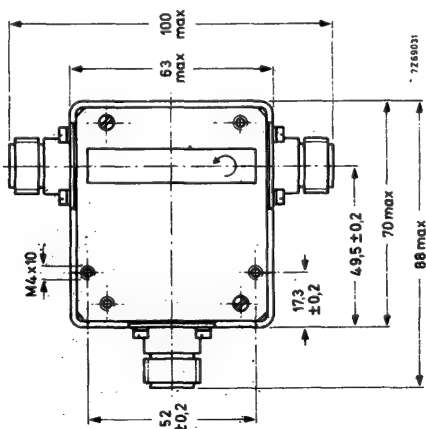
COAXIAL CIRCULATOR/ISOLATOR SERIES (3-PORT VERSIONS), STANDARD BANDS

| frequency range | isolation dB | | insertion loss dB | | v.s.w.r. | | max. power W | | temperature range | connector type | mass approx g | catalogue number |
|--------------------|-----------------|-----|----------------------|------|-----------------|------|-----------------|---------|----------------------|-------------------|---------------------|---------------------|
| | guaran- teed | typ | guaran- teed | typ | guaran- teed | typ | forward | reverse | | | | |
| GHz | | | | | | | | | °C | | | |
| 0,225-0,27 | > 18 | 21 | < 0,35 | 0,2 | < 1,35 | 1,25 | 150 | - | 0 to + 70 | N-female | 725 | 2722 162 01931 |
| 0,27 -0,33 | > 18 | 21 | < 0,35 | 0,2 | < 1,35 | 1,25 | 150 | - | 0 to + 70 | N-female | 725 | 2722 162 01941 |
| 0,33 -0,40 | > 18 | 21 | < 0,35 | 0,3 | < 1,35 | 1,25 | 150 | - | 0 to + 70 | N-female | 725 | 2722 162 01951 |
| 0,79 -1 | > 20 | 25 | < 0,5 | 0,3 | < 1,25 | 1,14 | 100 | - | -10 to + 60 | N-female | 400 | 2722 162 03261 |
| 0,96 -1,225 | > 20 | 22 | < 0,5 | 0,35 | < 1,25 | 1,20 | 100 | - | -10 to + 60 | N-female | 460 | 2722 162 03591 |
| 1,48 -1,95 | > 20 | 28 | < 0,3 | 0,3 | < 1,2 | 1,08 | 50 | 2 | 0 to + 70 | N-female | 500 | 2722 162 02041 |
| 3,8 -4,2 | > 25 | 27 | < 0,25 | 0,2 | < 1,12 | 1,10 | 10 | - | -10 to + 70 | SMA | 110 | 2722 162 03431 |
| 4,4 -5 | > 25 | 27 | < 0,25 | 0,2 | < 1,12 | 1,10 | 10 | - | -10 to + 70 | SMA | 110 | 2722 162 03441 |
| 7,9 -10,4 | > 20 | 22 | < 0,4 | 0,35 | < 1,25 | 1,23 | 5 | 1 | -10 to + 70 | SMA | 30 | 2722 162 02231 |





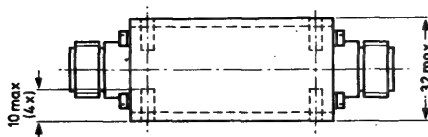
2722 162 02041

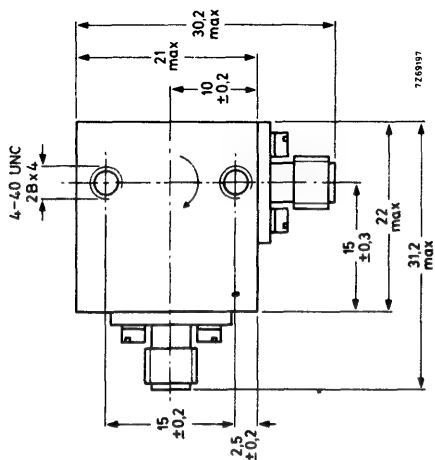


2722 162 01931
01941
01951
03591

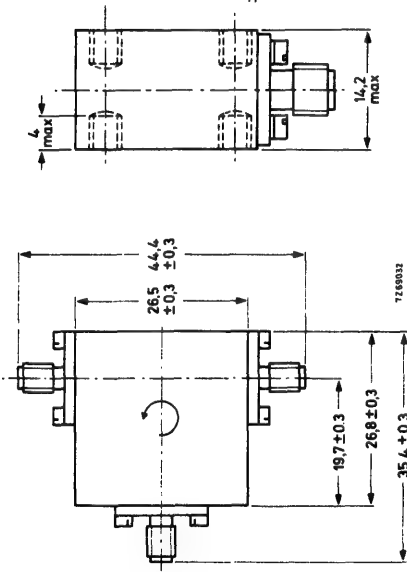
2722 162 03261

OUTLINES





2722 162 02231



2722 162 03431
03441

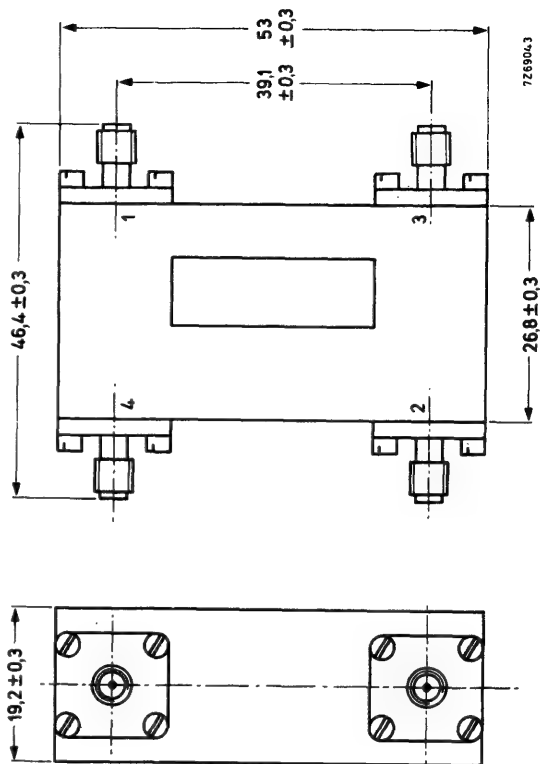
COAXIAL CIRCULATOR SERIES (4-PORT VERSIONS), STANDARD BANDS

| frequency range | isolation (dB) | | insertion loss (dB) | | v.s.w.r. | | max. (c.w.) power | temperature range | connector type | catalogue number |
|--------------------|----------------|--------------|---------------------|--------------|--------------|--------------|-------------------------|----------------------|-------------------|---------------------|
| | | | | | | | | | | |
| | guaranteed | typical | guaranteed | typical | guaranteed | typ | | | | |
| GHz | α_1-4 | α_1-4 | α_4-1 | α_1-2 | α_4-1 | α_1-2 | W | °C | | |
| | α_3-2 | α_4-2 | α_2-3 | α_3-4 | α_2-3 | α_3-4 | | | | |
| 3,8-4,2 | > 25 | > 50 | 27 | 52 | < 0,25 | < 0,5 | 10 | -10 to +70 | SMA | 2722 162 04031 |
| 4,4-5 | > 25 | > 50 | 27 | 52 | < 0,25 | < 0,5 | 10 | -10 to +70 | SMA | 2722 162 04041 |

Mass of circulators: 220 g approx.

OUTLINES

Dimensions in mm

2722 162 04031
04041

WAVEGUIDE CIRCULATOR SERIES (3-PORT VERSIONS)

| frequency range GHz | isolation (dB) | | insertion loss (dB) | | v.s.w.r. | | max. power W | temperature range °C | flange type (IEC) * | mass approx g | catalogue number |
|---------------------------|----------------|-----|---------------------|------|------------|------|--------------------|----------------------------|---------------------------|---------------------|---------------------|
| | guaranteed | typ | guaranteed | typ | guaranteed | typ | | | | | |
| 3,4 -3,8 | > 28 | 35 | < 0,4 | 0,15 | < 1,08 | 1,04 | 50 | 0 to + 50 | UER40 | 1500 | 2722 161 02261 |
| 3,8 -4,2 | > 28 | 35 | < 0,2 | 0,15 | < 1,08 | 1,04 | 50 | 0 to + 50 | UER40 | 1500 | 2722 161 02231 |
| 5,925-6,425 | > 30 | 35 | < 0,2 | 0,15 | < 1,06 | 1,04 | 100 | -10 to + 70 | UER70 | 950 | 2722 161 02101 |
| 6,425-7,125 | > 30 | 33 | < 0,15 | 0,13 | < 1,07 | 1,04 | 100 | -10 to + 70 | UER70 | 950 | 2722 161 02081 |
| 7,125-7,750 | > 30 | 33 | < 0,2 | 0,13 | < 1,06 | 1,04 | 100 | -10 to + 70 | UER70 | 950 | 2722 161 02091 |
| 7,7 -8,5 | > 25 | 32 | < 0,5 | 0,2 | < 1,1 | 1,05 | 50 | +10 to + 40 | UER84 | 825 | 2722 161 02191 |
| 7,7 -8,5 | > 25 | 28 | < 0,5 | 0,3 | < 1,1 | 1,08 | 50 | +10 to + 40 | UER84 | 825 | 2722 161 02281 |
| 7,9 -8,4 | > 30 | 33 | < 0,3 | 0,15 | < 1,06 | 1,04 | 50 | +10 to + 40 | UER84 | 825 | 2722 161 02271 |

Note

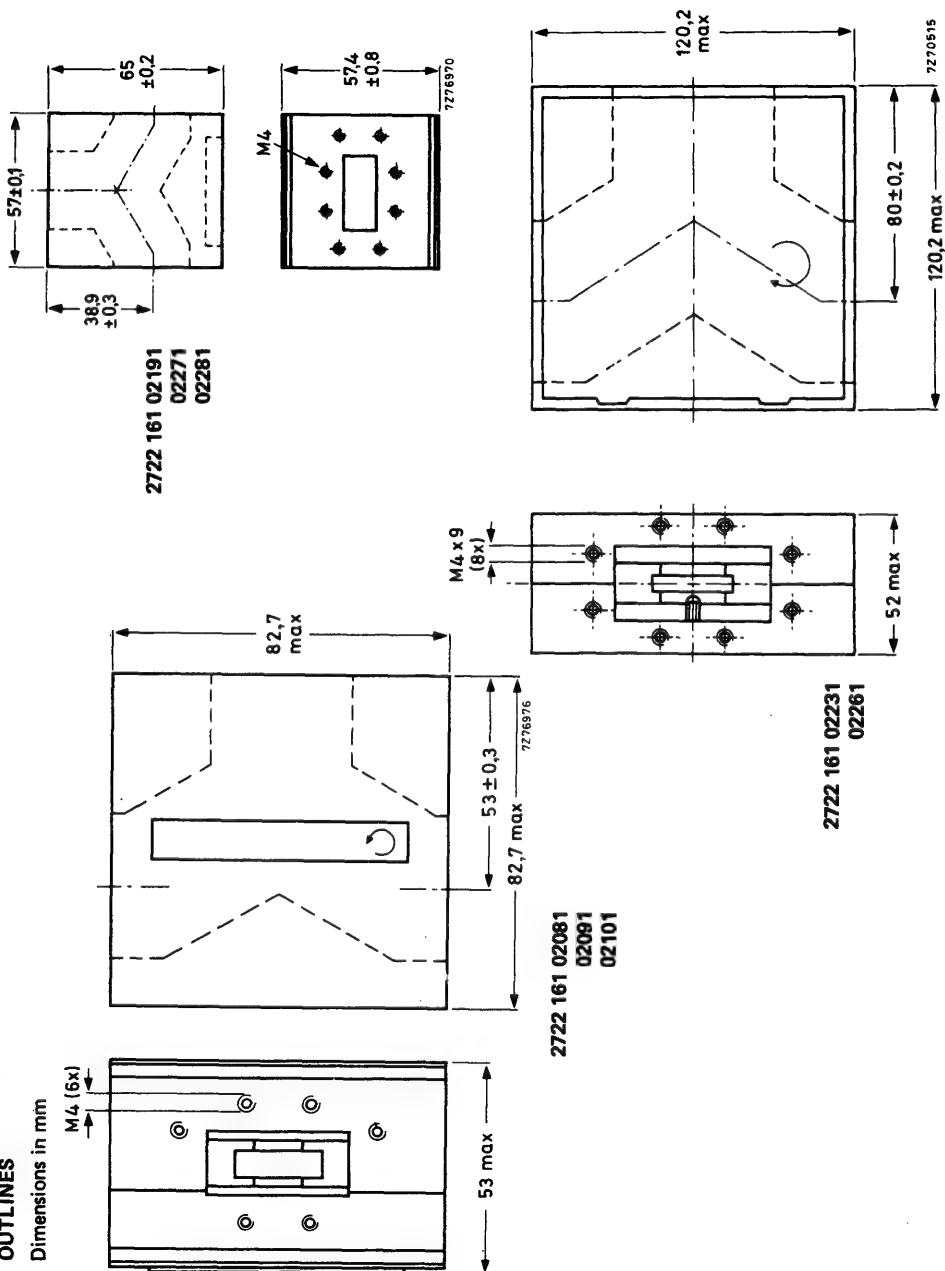
On request, 3-port versions can be coupled to form n-ports.

* Material of flanges: aluminium. Finish of flanges: alodine.



OUTLINES

Dimensions in mm



WAVEGUIDE CIRCULATOR SERIES (4-PORT VERSIONS)

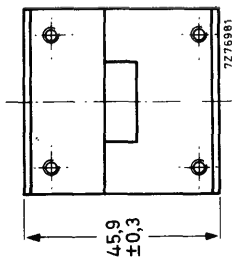
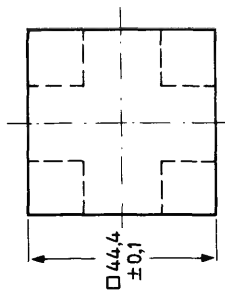
| frequency range GHz | isolation (dB) | | insertion loss (dB) | | v.s.w.r. | | nominal power (c.w.) W | temperature range °C | flange type (IEC) * | mass approx g | catalogue number |
|---------------------------|----------------|--------------|---------------------|------|--------------|--------------|------------------------------|----------------------------|---------------------------|---------------------|---------------------|
| | α_1-3 | α_1-4 | guaranteed | typ | α_1-3 | α_1-4 | | | | | |
| 5,925-6,175 | > 33 | > 20 | < 0,1 | 0,10 | < 1,05 | < 1,04 | 150 | + 10 to + 60 | UER70 | 920 | 2722 161 03081 |
| 6,125-6,425 | > 30 | > 20 | < 0,1 | 1,10 | < 1,06 | < 1,06 | 150 | + 10 to + 60 | UER70 | 920 | 2722 161 03091 |
| 6,575-6,875 | > 25 | > 20 | < 0,4 | 0,35 | < 1,10 | < 1,10 | 100 | + 10 to + 60 | UER70 | 920 | 2722 161 03031 |
| 6,825-7,125 | > 25 | > 18 | < 0,4 | 0,35 | < 1,08 | < 1,08 | 100 | + 10 to + 60 | UER70 | 920 | 2722 161 03011 |
| 7,125-7,425 | > 25 | > 18 | < 0,3 | 0,25 | < 1,10 | < 1,10 | 100 | + 10 to + 60 | UER70 | 920 | 2722 161 03001 |
| 7,425-7,725 | > 30 | > 20 | < 0,4 | 0,35 | < 1,10 | < 1,10 | 100 | + 10 to + 60 | UER70 | 920 | 2722 161 03041 |
| 10,7 -11,7 | > 30 | > 18 | < 0,3 | 0,25 | < 1,10 | < 1,10 | 25 | + 10 to + 60 | UER100 | 390 | 2722 161 03061 |
| 12,5 -13,5 | > 25 | > 20 | < 0,3 | 0,25 | < 1,10 | < 1,10 | 25 | + 10 to + 60 | UER140/ UBR140 | 320 | 2722 161 03051 |

* Material of flange: brass. Finish of flange: gold on silver plate.

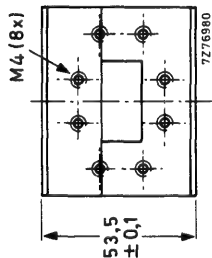
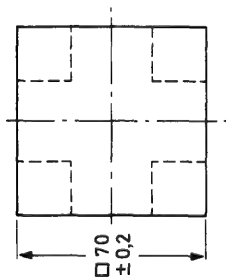


OUTLINES

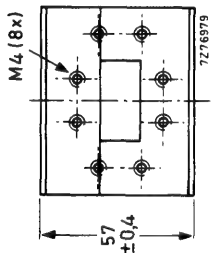
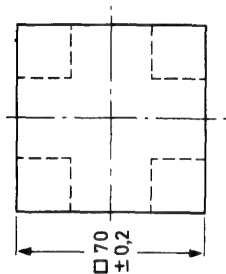
Dimensions in mm



2722 161 03061



2722 161 03041



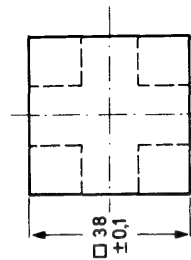
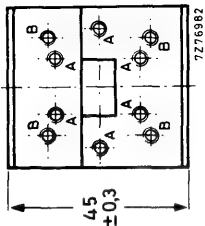
2722 161 03001

03011

03031

03081

03091

A for IEC flange UER 140
B for IEC flange UBR 140

2722 161 03051

INDUSTRIAL HEATING ISOLATORS

| frequency range GHz | isolation dB | | insertion loss dB | | v.s.w.r. | | max. c.w. power forward/ reverse W | cooling water temp. (°C) (water pressure 600 kPa abs) | | flange type (IEC) * | h.f. monitoring terminal | mass approx kg | catalogue number |
|-------------------------------|-----------------|-----|----------------------|-----|-----------------|-----|--|--|--------|------------------------------|--------------------------------|----------------------|---------------------|
| | guaran- teed | typ | guaran- teed | typ | guaran- teed | typ | | inlet | outlet | | | | |
| 2,425-2,475 | > 20 | 26 | < 0,3 | 0,2 | < 1,2 | 1,1 | 6500 | 40 | 50 | PDR26 | N-female | 4,7 | 2722 163 02004 |
| 2,350-2,400 | > 20 | 26 | < 0,3 | 0,2 | < 1,2 | 1,1 | 6500 | 40 | 50 | PDR26 | N-female | 4,7 | 2722 163 02024 |

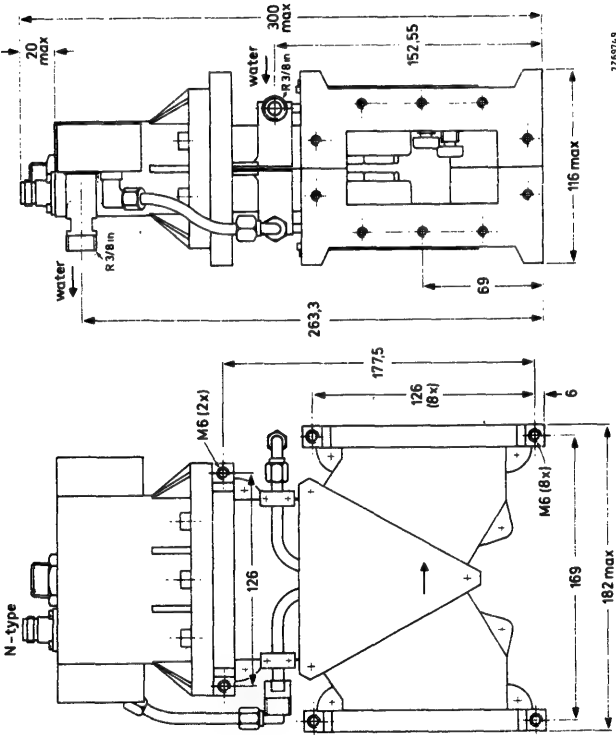
Note

Minimum storage temperature, -10 °C.

* Finish of flange/housing: alodine.

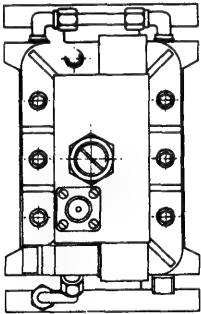


Dimensions in mm



726974.9

2722 163 02004
02024



OUTLINES

WAVEGUIDE ISOLATOR SERIES

| frequency range GHz | isolation dB | insertion loss dB | v.s.w.r. | power (c.w.) W | temperature range °C | waveguide type (IEC) | flange type (IEC) * | mass approx g | catalogue number |
|---------------------------|-----------------|-------------------------|----------|----------------------|----------------------------|-------------------------|---------------------------|---------------------|---------------------|
| 3,8 -4,2 | > 30 | < 0,8 | < 1,05 | 10 | + 10 to + 40 | R48 | UER48 | 1700 | 2722 161 01071 |
| 3,8 -4,2 | > 30 | < 0,5 | < 1,05 | 10 | + 10 to + 80 | R40 | UER40 | 2450 | 2722 161 01081 |
| 4,2 -4,6 | > 30 | < 0,5 | < 1,05 | 10 | + 10 to + 40 | R48 | UER48 | 1680 | 2722 161 01091 |
| 4,6 -5,0 | > 30 | < 0,8 | < 1,05 | 10 | + 10 to + 40 | R48 | UER48 | 1680 | 2722 161 01101 |
| 5,925-6,425 | > 30 | < 0,3 | < 1,05 | 20 | -10 to + 70 | R70 | UER70 | 1450 | 2722 161 01191 |
| 6,425-7,150 | > 30 | < 0,3 | < 1,05 | 20 | -10 to + 70 | R70 | UER70 | 1450 | 2722 161 01251 |
| 6,825-7,425 | > 30 | < 0,3 | < 1,05 | 20 | -10 to + 70 | R70 | UER70 | 1450 | 2722 161 01231 |
| 7,125-7,750 | > 30 | < 0,3 | < 1,05 | 20 | -10 to + 70 | R70 | UER70 | 1450 | 2722 161 01291 |
| 7,250-7,750 | > 30 | < 0,3 | < 1,05 | 20 | -10 to + 70 | R70 | UER70 | 1450 | 2722 161 01241 |
| 7,4 -8,025 | > 30 | < 0,5 | < 1,05 | 10 | -10 to + 70 | R70 | UER70 | 1450 | 2722 161 01151 |
| 7,7 -8,5 | > 30 | < 0,5 | < 1,05 | 10 | + 10 to + 70 | R84 | UBR84 | 1260 | 2722 161 01161 |
| 8,5 -9,6 | > 30 | < 0,5 | < 1,05 | 10 | -10 to + 70 | R100 | UBR100 | 420 | 2722 161 01211 |
| 8,5 -9,6 | > 15 | < 0,6 | < 1,15 | 1 | + 10 to + 70 | R100 | UBR100 | 400 | 2722 161 01221 |
| 8,5 -9,6 | > 55 | < 1,2 | < 1,2 | 10 | -10 to + 70 | R100 | 154-UER100** | 600 | 2722 161 01261 |
| 8,5 -9,6 | > 20 | < 1 | < 1,15 | 10 | -10 to + 70 | R100 | 154-UBR100** | 300 | 2722 161 01271 |
| 10,7 -11,7 | > 30 | < 0,8 | < 1,05 | 5 | + 10 to + 70 | R100 | UBR100 | 430 | 2722 161 01171 |
| 12,5 -13,5 | > 30 | < 0,5 | < 1,05 | 10 | + 10 to + 70 | R140 | UBR100 | 220 | 2722 161 01181 |

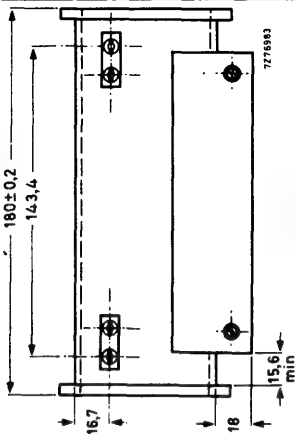
* Other flanges to order. Finish of waveguide and flanges: gold plate.

** Finish of flanges: nickel plate.

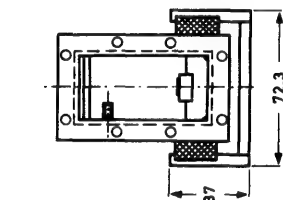


OUTLINES

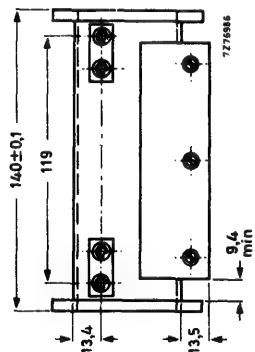
Dimensions in mm



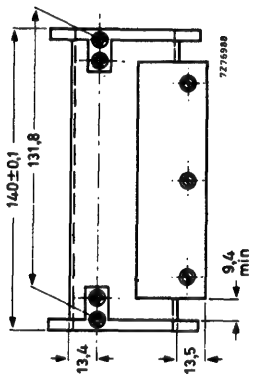
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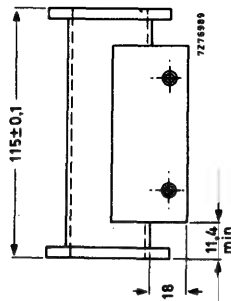
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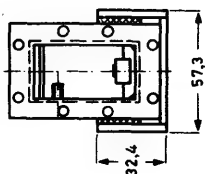
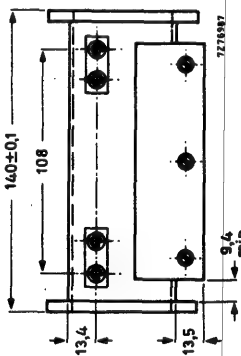
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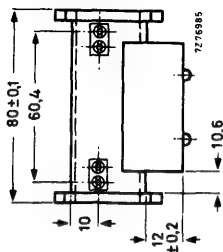


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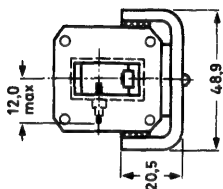


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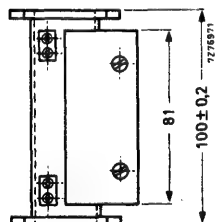
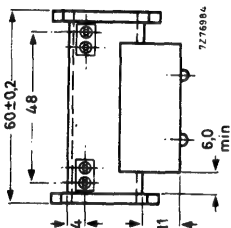




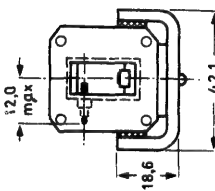
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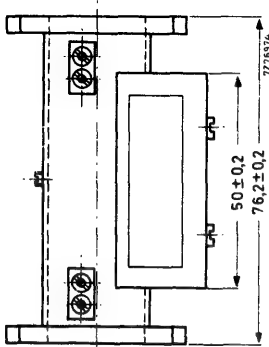
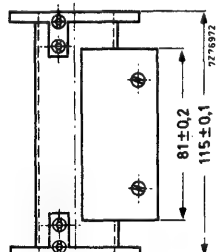
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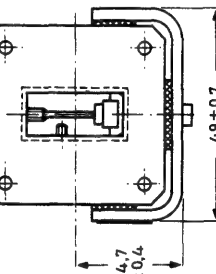
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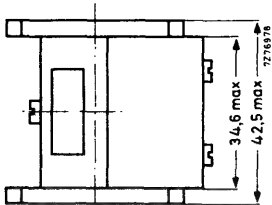


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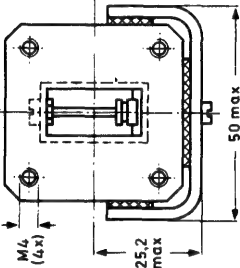


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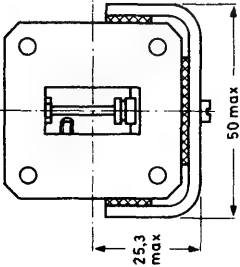
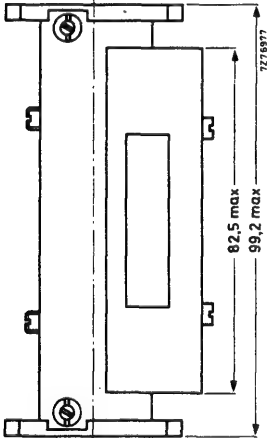




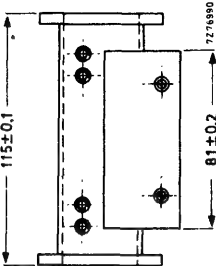
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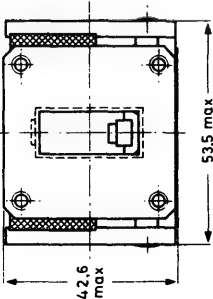
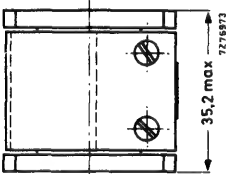
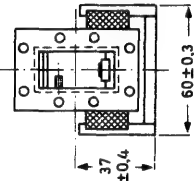
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2722 161 01221



2722 161 01231
01241
01291



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| Catalogue Number 2722 161 | Type Number |
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| 01071 | CL6201 |
| 01081 | CL6240 |
| 01091 | CL6202 |
| 01101 | CL6203 |
| 01151 | CL6210 |
| 01161 | CL6214 |
| 01171 | CL6215 |
| 01181 | CL6217 |
| 01191 | CL6206 |
| 01211 | CL6222 |
| 01221 | CL6221 |
| 01231 | CL6231 |
| 01241 | CL6241 |
| 01251 | CL6251 |
| 01261 | CL6261 |
| 01271 | CL6271 |
| 01291 | CL6291 |
| 02081 | CL5281 |
| 02091 | CL5291 |
| 02101 | CL5101 |
| 02191 | CL5219 |
| 02231 | CL5232 |
| 02261 | CL5263 |
| 02271 | CL5227 |
| 02281 | CL5283 |
| 03001 | CL5050 |
| 03011 | CL5051 |
| 03031 | CL5053 |
| 03041 | CL5054 |
| 03051 | CL5055 |
| 03061 | CL5056 |
| 03081 | CL5081 |
| 03091 | CL5091 |

| Catalogue Number 2722 162 | Type Number |
|------------------------------------|----------------|
| 01121 | CL5027 |
| 01131 | CL5028 |
| 01141 | CL5029 |
| 01261 | CL5261 |
| 01271 | CL5271 |
| 01281 | CL5282 |
| 01331 | CL5331 |
| 01491 | CL5491 |
| 01501 | CL5501 |
| 01511 | CL5511 |
| 01551 | CL5551 |
| 01561 | CL5561 |
| 01572 | CL5372 |
| 01582 | CL5382 |
| 01592 | CL5392 |
| 01612 | CL5312 |
| 01622 | CL5322 |
| 01632 | CL5332 |
| 01642 | CL5342 |
| 01662 | CL5362 |
| 01811 | CL5811 |
| 01821 | CL5821 |
| 01851 | CL5851 |
| 01861 | CL5861 |
| 01871 | CL5871 |
| 01881 | CL5881 |
| 01891 | CL5891 |
| 01901 | CL5901 |
| 01931 | CL5931 |
| 01941 | CL5941 |
| 01951 | CL5951 |
| 02041 | CL6041 |
| 02071 | CL6071 |



| Catalogue Number 2722 162 | Type Number |
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| 02091 | CL6091 |
| 02101 | CL6101 |
| 02111 | CL6111 |
| 02121 | CL6122 |
| 02221 | CL6223 |
| 02231 | CL6232 |
| 03171 | CL5172 |
| 03181 | CL5182 |
| 03261 | CL5262 |
| 03301 | CL5301 |
| 03411 | CL5411 |
| 03431 | CL5431 |
| 03441 | CL5441 |
| 03591 | CL5592 |
| 04031 | CL5032 |
| 04041 | CL5042 |

| Catalogue Number 2722 163 | Type Number |
|--|----------------|
| 02004 | CL6204 |
| 02024 | CL6224 |



| Type Number | Catalogue Number |
|----------------|---------------------|
| CL5027 | 2722 162 01121 |
| CL5028 | 2722 162 01131 |
| CL5029 | 2722 162 01141 |
| CL5032 | 2722 162 04031 |
| CL5042 | 2722 162 04041 |
| CL5050 | 2722 161 03001 |
| CL5051 | 2722 161 03011 |
| CL5053 | 2722 161 03031 |
| CL5054 | 2722 161 03041 |
| CL5055 | 2722 161 03051 |
| CL5056 | 2722 161 03061 |
| CL5081 | 2722 161 03081 |
| CL5091 | 2722 161 03091 |
| CL5101 | 2722 161 02101 |
| CL5172 | 2722 162 03171 |
| CL5182 | 2722 162 03181 |
| CL5219 | 2722 161 02191 |
| CL5227 | 2722 161 02271 |
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| CL5281 | 2722 161 02081 |
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| CL5331 | 2722 162 01331 |
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| Type Number | Catalogue Number |
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| CL5362 | 2722 162 01662 |
| CL5372 | 2722 162 01572 |
| CL5382 | 2722 162 01582 |
| CL5392 | 2722 162 01592 |
| CL5411 | 2722 162 03411 |
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| CL5592 | 2722 162 03591 |
| CL5811 | 2722 162 01811 |
| CL5821 | 2722 162 01821 |
| CL5851 | 2722 162 01851 |
| CL5861 | 2722 162 01861 |
| CL5871 | 2722 162 01871 |
| CL5881 | 2722 162 01881 |
| CL5891 | 2722 162 01891 |
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| Type Number | Catalogue Number |
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| CL6204 | 2722 163 02004 |
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| CL6210 | 2722 161 01151 |
| CL6214 | 2722 161 01161 |
| CL6215 | 2722 161 01171 |
| CL6217 | 2722 161 01181 |
| CL6221 | 2722 161 01221 |
| CL6222 | 2722 161 01211 |
| CL6223 | 2722 162 02221 |
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